Report for years 1949-51 of the Botanical Division of the Rubber Research Institute of Malaya

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PREFACE

IT HAS BEEN THE CUSTOM to publish annually the reports of the several Divisions of the R.R.I. together with an introductory survey by the Director.

During the period of recovery after the war, publication of progress reports was delayed. The reports of the Divisions from September 1945 to the end of 1948 were issued as a single publication. Separate publications on specific subjects of research have continued to appear as Communications to the Journal of the R.R.I., but formal Annual Reports have not been published.

Postwar plans for research and development have crystallised and have been formally embodied in the Malayan Rubber Fund Five Years Plan 1949-53. The work of the R.R.I. since 1948 may therefore be reviewed in relation to the general research programme laid down for the five years.

This individual report is one of a number which together will constitute a general report for 1949-51. The whole may thus be regarded as an interim report on the workings of the five years plan. The numbering of sections under the chapter heading INVESTIGATIONS is that adopted in the general research programme.

When the decision was reached to issue a general report for the three years 1949-1951 the additional data obtained in 1951 were incorporated by Mr H.M. Burkill, acting as Head of Division, with the reports for the two previous years which had been prepared and submitted by the Head of the Division.

The Report for the years 1949-51 of the Botanical Division is presented.

Director

BOTANICAL DIVISION
1949-51

RUBBER RESEARCH INSTITUTE OF MALAYA
KUALA LUMPUR

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STAFF

MR C.C.T. SHARP, HEAD OF THE DIVISION at the opening of the period of this report, acted for the Director from 30 January to 11 March 1949. He proceeded on sick leave on 15 September 1949 and resumed duty on 1 April 1950. He acted for the Director again from 12 April to 23 November 1950 and was appointed Deputy Director on 24 November 1950.

Dr E.D.C. Baptist returned from long leave on 5 September 1949 and acted as Head of the Division from 15 September 1949 to 31 March 1950 and again from 12 April to 23 November 1950. He was appointed Head of the Division on 24 November 1950.

Mr E.G.B. Gooding continued to act as Smallholders' Advisory Officer until 5 March 1949 when he returned to the Division. He was on duty until 27 March 1950 when he went on long leave, and while still on leave he resigned his appointment.

Mr H.M. Burkill was on duty throughout 1949 and 1950 until 29 December 1950 when he went on long leave. While on leave in England he undertook work at the Commonwealth Mycological Institute and at the Royal Botanic Gardens, Kew, in connection with the international exchange of *Hevea* planting material. He resumed duty in Malaya on 18 September 1951.

Mr C.W. Brookson assumed duty on appointment as Botanist on 23 August 1949. Except for the period from 1 February to 14 March 1950, when he was engaged on fulltime duty with the Malayan Peoples' Anti-Bandit Month Organisation, he was on duty throughout the remaining period covered by this report.

Ir P. de Jonge assumed duty on appointment as Botanist on 29 December 1950 and was on duty throughout the remaining period covered by this report.

Mr K.N. Kaimal was on duty throughout 1949 and until 10 April 1950, when he resigned his appointment and left for India to join the Indian Rubber Board as Rubber Production Commissioner. Mr T.V. Vaidyanathan was on duty throughout 1949, 1950 and until 9 December 1951 when he went on long leave.

At the end of 1951 appointments for three senior officers (Physiologist, Latex Physiologist, and Taxonomist) and one Assistant Botanist remained unfilled.

Junior Staff — The strength of the junior staff on the Division at the end of 1951 was as follows: at the Institute, 2 field assistants, 9 laboratory assistants, 1 stenographer, 2 laboratory attendants; at the R.R.I. Experiment Station, 6 field assistants, 1 budding mandor.

The death on 6 May 1951 of Mr S. Subramaniam, one of the earliest laboratory assistants to be appointed to the Division, is recorded with regret.

INVESTIGATIONS

I

BREEDING AND SELECTION

(1) POLLINATION

1949 Programme — The programme of hand pollinations included crosses which could not be made in 1948 owing to the failure of certain clones to produce sufficient flowers, notably TK 14 which produced none. The 1949 flowering season was very short and since many of the clones intended for use as parents produced no flower, the pollination programme had again to be curtailed.

New clones used for the first time were 34/162 (RRIM 504 × Tjir 1) and RRIM 83. The last named clone was made from a high yielding estate mother tree selected in 1930 and was chosen for its exceptional vigour and good bark characters, although it is only a moderate yielder. Details of the crosses made are given in TABLE I.

1950 Programme — A normal flowering season was experienced and thirteen crosses were carried out, three of them being between a clone of *Hevea spruceana* established on the R.R.I. Experiment Station in December 1932 and the *Hevea brasiliensis* clones, Tjir 1, Pil B84 and RRIM 501. The details of crosses made are given in TABLE II.

1951 Programme — Unusually wet weather was experienced at the beginning of the year. This postponed wintering; flowering, which normally commences in February or March, did not begin until May on the R.R.I. Experiment Station.

Details of the crosses made are given in TABLE III. Two crosses, RRIM 604 × PB 49 and RRIM 605 × RRIM 622 yielded no fruit, and one cross, RRIM 607 × Tjir 1 gave only non-viable seed. There are good indications that RRIM 604 and RRIM 606 which are sibling progeny of Tjir 1 × PB 49 show fertility above average when back crossed with Tjir 1.

I(2) LARGE SCALE PRODUCTION OF IMPROVED SEEDLINGS

Collection of clonal seed for smallholders under Colonial Development and Welfare Scheme, D.1176 — Collections of clonal seed of selected parentage on estates were begun in 1948 and were continued until March 1949. A total of 1,699,200 seed during the 1948-9 seedfall was collected under the supervision of Botanical Division staff. Out of this total one third (531,260 seed) was obtained during the secondary seedfall of January to March 1949.

TABLE I: RESULTS OF HAND POLLINATION 1949

Cross	*Origin of the parents*		*Pollinations made*	*Fruits harvested*	*Successes %*	*Seeds planted*	*Seeds germinated*	*Germination %*
RRIM 83 × Tjir 1	*RRI Selection*	*Estate selection*	624	28	4.5	84	42	50.0
RRIM 83 × RRIM 501	„	*Pil A44 × Lun N*	710	59	8.3	177	164	92.7
RRIM 83 × RRIM 509	„	*Pil A44 × Lun N*	387	15	4.0	45	42	93.3
RRIM 83 × RRIM 500	„	*Pil B84 × Pil A4*	420	24	5.7	72	56	77.8
RRIM 83 × RRIM 507	„	*Pil B84 × Pil A44*	652	31	4.8	93	62	66.7
RRIM 83 × Lun N	„	*Estate selection*	533	17	3.2	51	30	58.8
RRIM 83 × 32/599 (600)	„	*Tjir 1 × PB 86*	85	–	–	–	–	–
RRIM 83 × 34/320 (614)	„	*Tjir 1 × RRIM 509*	36	1	2.8	3	3	100.0
44/553 × Lun N	*Tjir 1 × Pil B84*	*Estate selection*	58	3	5.2	9	8	88.9
34/320 (614) × RRIM 500	*Tjir 1 × RRIM 500*	*Pil B84 × Pil A44*	306	5	1.6	15	–	–
32/599 (600) × RRIM 501	*Tjir 1 × PB 86*	*Pil A44 × Lun N*	309	34	11.0	102	89	85.4
32/599 (600) × TK 14	*Tjir 1 × PB 86*	*Estate selection*	59	–	–	–	–	–
32/599 (600) × Lun N	*Tjir 1 × PB 86*	*Estate selection*	47	1	2.1	3	3	100.0
34/162 (610) × RRIM 500	*RRIM 504 × Tjir 1*	*Pil B84 × Pil A44*	393	29	7.4	84	47	54.0
34/162 (610) × RRIM 83	*RRIM 504 × Tjir 1*	*RRIM Selection*	303	–	–	–	–	–
TOTAL			4922	247	5.0	738	546	73.9

This programme was carried out before the selection of the RRIM 600 Series clones had been undertaken. Seeds of these clones which were used as parents are recorded in the table above under their small scale clone trial numbers, while the 600 Series clone numbers which were later given are shown in brackets.

TABLE II: RESULT OF HAND POLLINATIONS 1950

Cross	*Origin of the parents*		*Pollinations made*	*Fruits harvested*	*Successes %*	*Seeds planted*	*Seeds germinated*	*Germination %*
34/373 × Tjir 1	*RRIM 504 × RRIM 509*	*Estate selection*	603	12	2.0	37	18	48.6
34/373 × 32/599	*RRIM 504 × RRIM 509*	*Tjir 1 × PB 86*	540	19	3.5	57	55	96.4
34/373 × Pil B84	*RRIM 504 × RRIM 509*	*Estate selection*	88	–	–	–	–	–
34/373 × TK 14	*RRIM 504 × RRIM 509*	*Estate selection*	204	14	6.9	42	34	81.0
RRIM 600 (32/599) × Tjir 1	*Tjir 1 × PB 86*	*Estate selection*	575	25	4.3	79	49	62.0
RRIM 600 (32/599) × BR 2	*Tjir 1 × PB 86*	*Estate selection*	39	6	15.4	18	12	66.6
RRIM 600 (32/599) × TK 14	*Tjir 1 × PB 86*	*Estate selection*	383	12	3.1	37	23	62.1
RRIM 600 (32/599) × RRIM 500	*Tjir 1 × PB 86*	*Pil B84 × Pil A44*	402	4	1.0	12	4	33.3
RRIM 600 (32/599) × RRIM 83	*Tjir 1 × PB 86*	*RRIM selection*	459	5	1.1	15	14	93.3
RRIM 610 (34/162) × RRIM 507	*RRIM 504 × Tjir 1*	*Pil B84 × Pil A44*	412	8	1.9	24	18	75.0
			3705	105	2.8	321	227	70.7
H. spruceana × Tjir 1	*Hevea spruceana*	*Estate selection*	755	37	4.9	116	80	69.0
H. spruceana × Pil B84	*Hevea spruceana*	*Estate selection*	142	–	–	–	–	–
H. spruceana × RRIM 501	*Hevea spruceana*	*Pil A44 × Lun N*	745	9	1.2	27	24	88.8
			1642	46	2.8	143	104	72.7
TOTAL			5347	151	2.8	464	331	71.3

TABLE III: RESULT OF HAND POLLINATIONS 1951

Cross	Origin of the parents		Nature of cross	Pollinations made	Fruits harvested	Successes %	Seeds planted	Seeds germinated	Germination %
RRIM 600 × RRIM 83	*Tjir 1 × PB 86*	*RRIM selection*	*Out*	265	8	3.0	24	22	91.7
RRIM 605 × 38/367	*Tjir 1 × PB 49*	*RRIM 500 × Lun N*	*Out*	118	4	3.4	12	6	50.0
RRIM 605 × RRIM 618	*Tjir 1 × PB 49*	*Lun N × RRIM 501*	*Out*	426	16	2.8	36	30	62.5
RRIM 605 × RRIM 71	*Tjir 1 × PB 49*	*RRIM selection*	*Out*	390	23	5.9	69	59	85.5
RRIM 605 × 38/317	*Tjir 1 × PB 49*	*Tjir 1 × Pil B84*	*½ sibling*	154	–	–	–	–	–
RRIM 600 × Tjir 1	*Tjir 1 × PB 86*	*Estate selection*	*Back*	424	12	2.8	38	33	86.8
RRIM 600 × PB 86	*Tjir 1 × PB 86*	*Estate selection*	„	342	7	2.0	21	19	90.5
RRIM 604 × Tjir 1	*Tjir 1 × PB 49*	*Estate selection*	„	112	12	10.7	36	21	58.3
RRIM 604 × PB 49	*Tjir 1 × PB 49*	*Estate selection*	„	299	–	–	–	–	–
RRIM 605 × Tjir 1	*Tjir 1 × PB 49*	*Estate selection*	„	569	32	5.6	96	74	77.1
RRIM 605 × PB 49	*Tjir 1 × PB 49*	*Estate selection*	„	320	14	4.4	42	23	54.8
RRIM 606 × Tjir 1	*Tjir 1 × PB 49*	*Estate selection*	„	142	20	14.1	62	52	83.9
RRIM 607 × Tjir 1	*Tjir 1 × PB 49*	*Estate selection*	„	258	10	3.9	30	–	–
34/373 × 34/373	*RRIM 504 × RRIM 509*		*Self*	230	3	1.3	9	–	–
RRIM 605 × RRIM 605	*Tjir 1 × PB 49*		*Self*	178	15	8.4	45	37	82.2
Lun N × Lun N	*Estate selection*		*Self*	107	2	1.9	6	6	100.0
TOTAL				4334	178	4.1	538	382	71.0

Seed gardens established under the Colonial Development and Welfare Scheme, D.1176 — An area of 178 acres was planted on a hedge system with intervals of 60 feet between rows and 4½ feet along the row. The area has been divided into four separate seed gardens of clonal composition shown below. Gardens *A* and *B* were budded in 1950, *C* and *D* in 1951.

Garden *A* (40 acres) Tjir 1, RRIM 501, PR 107, TK 14, BR 2
„ *B* (39 „) Tjir 1, RRIM 509, AVROS 157, PB 49, BR 2
„ *C* (32 „) Tjir 1, RRIM 509, AVROS 157, PB 49, RRIM 526
„ *D* (67 „) Tjir 1, RRIM 501, PR 107, PB 49, RRIM 527

In these gardens the clones were budded in succession along the rows, two adjacent seedlings to each clone in *A* and *B* and three adjacent seedlings to each clone in *C* and *D*, in the order 1, 2, 3, 4, 5, 1, 3, 5, 2, 4, 1, 2, 3, 4, 5, *etc.* The same order was followed across the hedge rows. The original planting density was 161 points per acre. A final stand of about 80 seed bearing trees is intended.

A further area of about 13 acres of the same planting was also budded with Tjir 1, PR 107 and RRIM 501, but the clones were budded by complete rows to each clone.

I(3) GENETICAL STUDIES: CYTOGENETICS OF HEVEA

An attempt was made to induce polyploidy in young seedlings of *Hevea brasiliensis* by immersion of the growing point of the plumule two, six or twelve hours in solutions of 0.4% and 0.2% colchicine. The action of the colchicine was enhanced by the use of a wetting agent (Dispersol L) at a dilution of 1 ml per litre. Over a thousand selfed seedlings of clone Tjir 1 were treated in this manner when the plumule was about four inches long and before the first leaves had unfolded. In one set of control seedlings the plumule was immersed in distilled water and in another it was immersed in a 0.1% solution of Dispersol L.

Malformation of the lamina of the first leaves which was observed in all colchicine treatments persisted in about 15% of the seedlings three months after planting out in the open. The small number of casualties (3%) obtained is a possible indication that the colchicine treatment was not drastic enough to induce sufficient c-mi.osis to form complete polyploid tissue. After eighteen months

only one seedling showed any abnormality. Buds of completely polyploid tissue may be present on other seedlings however, and to carry this experiment to completion all buds from the treated area of the main stem of the seedlings will be used for budding.

The components of a naturally occurring chimaera shown by an illegitimate seedling of clone Tjir 1 were examined by iron-acetocarmine smear. No difference in chromosome number and no gross disparity in shape could be demonstrated.

An attempt was made with Winkler's method to induce polyploidy in seedlings. Two buds produced on callus formed at the cut end of two decapitated seedlings did not survive.

I(4) EXAMINATION OF CRITERIA FOR SELECTION IN THE LABORATORY AND FIELD

A number of seedlings were test tapped on the ten day system for the first time in January 1932 at the age of $3\frac{1}{4}$ years and thereafter at intervals of 6 months until they were $5\frac{3}{4}$ years old.* The yields at test tapping have been correlated with the yields from regular tapping on S/2.d/2.100%. Details are set out in TABLE IV.

An attempt was made to extract rubber from *Hevea* leaves using a method adopted at the U.S. Natural Rubber Research Station, Salinas, California for determining the quantity of rubber in guayule (*Parthenium argentatum*). The *Hevea* leaf extracts proved variable and the results obtained were considered unreliable. The method will be re-examined as a high correlation has been reported† to exist between the rubber content of leaves of one year old buddings and the yield of the mature trees.

I(5) SELECTION OF INDIVIDUALS AND CLONES BASED ON QUALITY AND PROPERTIES OF LATEX AND RUBBER

Properties of rubber — Rubber from individual trees and trees of different clones (PB 186, Tjir 1 and six RRIM 500 Series Clones) has been examined in the Chemical Division. Statistically significant differences have been observed in their technological properties but these differences are not sufficiently marked to be of industrial importance.

The conclusion reached is that there is no justification for selecting clones on the technical quality of the rubber hydrocarbon,

* *Rep. Rubb. Res. Inst.* Malaya (1932)84, (1933)98, (1934)88, (1935)95, (1936)71, (1937)117, (1938)100, (1939)140, (1940)75, (1941-5)22, 37, (1945-8)40

† DE HAAN I. and VAN AGGELEN BOT G.M. *Arch Rubbercult. Ned.-Ind.* (1948) 26

TABLE IV: RELATIONSHIP BETWEEN YIELDS OF SEEDLING TREES AT TEST TAPPING AND YIELDS OBTAINED IN CONTINUOUS TAPPING

Age of trees at test tapping years	*Correlation coefficients (all positive) between yields on test tapping and yields at age in years*											
	$6\frac{1}{4}$-$7\frac{1}{4}$	$7\frac{1}{4}$-$8\frac{1}{4}$	$8\frac{1}{4}$-$9\frac{1}{4}$	$9\frac{1}{4}$-$10\frac{1}{4}$	$10\frac{1}{4}$-$11\frac{1}{4}$	$11\frac{1}{4}$-$12\frac{1}{4}$	$17\frac{1}{4}$-$18\frac{1}{4}$	$18\frac{1}{4}$-$19\frac{1}{4}$	*$19\frac{1}{4}$-$20\frac{1}{4}$	†$20\frac{1}{4}$-$21\frac{1}{4}$	$21\frac{1}{4}$-$22\frac{1}{4}$	$22\frac{1}{4}$-$23\frac{1}{4}$
$3\frac{1}{4}$	0.77	0.68	0.58	0.46	0.48	0.40	0.36	0.35	0.28	0.32	0.34	0.22
$3\frac{3}{4}$	0.75	0.76	0.64	0.53	0.53	0.47	0.39	0.37	0.30	0.31	0.34	0.22
$4\frac{1}{4}$	0.85	0.77	0.69	0.69	0.60	0.49	0.45	0.43	0.30	0.33	0.37	0.25
$4\frac{3}{4}$	0.83	0.86	0.65	0.54	0.45	0.47	0.48	0.42	0.32	0.37	0.39	0.26
$5\frac{1}{4}$	0.80	0.80	0.70	0.59	0.62	0.61	0.47	0.40	0.37	0.34	0.40	0.30
$5\frac{3}{4}$	0.85	0.83	0.74	0.64	0.64	0.59	0.50	0.44	0.39	0.36	0.43	0.32

Level of significance for $P = 0.01$, $r = 0.26$; *for* $P = 0.05$, $r = 0.20$

* *Height of tapping in January* 1948 = 12 *inches*

† *Height of tapping in January* 1949 = 40 *inches*

and that unfavourable characteristics such as poor latex stability or yellow colour, which are due to non-rubber constituents of the latex, can be corrected during processing.

An interesting finding was that the latices of clones RRIM 501, 504, 506 and 511 growing on a peat clay soil give higher modulus vulcanisates than the latices from the same clones of similar age growing on the light sandy soil of the R.R.I. Experiment Station.

The colour of the crepe prepared from the latices of the three highest yielding RRIM clones without fractional coagulation is pale yellow for clone RRIM 501, white for RRIM 513 and deep yellow for RRIM 527. The natural yellow colouring matter of latex may, however, be bleached by addition of emulsion A *.

Centrifuged concentrated latices — Latices of a selection of RRIM 500 Series clones were collected from experimental plantings on the R.R.I. Experiment Station and on estates, on different dates. Tests carried out in the Chemical Division on centrifuged concentrates preserved with 0.7% ammonia and after ten to eleven day's storage showed that the mechanical stability of the latex concentrate of a clone may vary between estates and between samples collected on different dates on the same estate. Generally the mechanical stability of the latex of clone RRIM 501 is on the low side whilst that of clone RRIM 513 is very high.

Premature coagulation of latex — Latex of clone PB 49 is prone to premature coagulation. Since clone PB 49 is an excellent seed parent, this undesirable characteristic has been looked for in the latices of its progeny and of the clones made from them. A number of seedlings and clones derived from PB 49 showed this feature on opening for tapping, but the number was found to have decreased appreciably after four years.

I(6) SELECTION FOR RESISTANCE TO DISEASE

Exchange and acquisition of planting material — With increasing international cooperation a considerable advance has been made during the period 1949 – 51 in schemes for the exchange of planting material. These exchanges are designed to provide the plant breeder with new material, selected for specific qualities, to facilitate the breeding of improved strains. Although seeds and budwood of *Hevea* do not for long retain a high viability, the reliability of air transport schedules and the careful handling of consignments by air companies have proved the ease with which despatches can be made across the world.

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* *R.R.I. Circular 35 (1952)*

Agreement was reached between the Rubber Research Institute of Malaya and the Instituto Agronomico do Norte at Belem, Brazil, to exchange R.R.I. high yielding clones for Brazilian clones developed for resistance to *Dothidella ulei* (South American leaf blight). Budwood of the *Dothidella* resistant clones destined for Malaya will be budded at the quarantine station of the United States Department of Agriculture at Coconut Grove, Miami, Florida, and the budwood grown there will be despatched to Malaya. An initial consignment of budwood from Brazil was received at Miami in 1951 and eight clones were established. The despatch of Malayan clones to Brazil and further Brazilian clones to Miami is to follow. It is expected that the whole exchange will involve twenty five clones from each country.

Under the Colonial Development and Welfare Scheme a quarantine station was set up at The Royal Botanic Gardens, Kew, for facilitating the exchange of tropical economic crops, primarily rubber and cacao.

Two consignments totalling 680 seeds of *Hevea* were dispatched to Kew from Malaya in 1949 to provide seedlings for use as stocks for budding and the multiplication of budwood grown in quarantine. A further consignment of 500 seeds was sent in 1950. In early 1951 from the 680 seeds of the first consignments there remained about 50 plants of which only 30 had any prospect of usefulness. The difficulty of growing *Hevea* in England, even under glass, without a specially heated and illuminated plant house was well demonstrated.

About 100 seedlings were raised at Kew from the seed received from Malaya in 1950. These seedlings were kept in a heated potting shed and supplied with artificial illumination and were in a much better condition than the older plants raised from seed dispatched from Malaya in 1949. All the seedlings were transferred to the new quarantine house on its completion in early April 1951 and with extra heating and the greater intensity of English summer sunlight the plants made fair growth during the following months.

Budwood of clones RRIM 501, 504, 507, 512 and 513 was despatched by air to England in June 1951 and was received at Kew in a poor condition, some of it fermented. Stripping of the bark was difficult, but six buddings were made of each clone on the most vigorous of the seedlings established at Kew in 1949. All the buddings failed though two were alive at opening.

Two budded stumps each of 24 RRIM clones (501, 507, 509, 511, 512, 513, 526, 527, 600, 602, 605, 606, 607, 608, 611, 613, 614, 616, 618, 620, 622, 623, 625, 626) were also despatched to Kew in

1949. The condition of these appeared to be good, but only eight were successfully established. The stumps were subject to severe taproot pruning on receipt at Kew in order to fit into available plant pots, and the failure of the majority to grow may be due partly to this drastic treatment.

The object of this work was to obtain information on the length of time necessary to produce budwood under plant house conditions at Kew Gardens and to grow budwood of these clones under quarantine for despatch to the western hemisphere for testing their resistance to South American leaf blight. As a result of observations on the growth of the Hevea seedlings at Kew, the plans for growing material in quarantine have been greatly modified. It is now likely that the quarantine house at Kew will only be employed if other methods fail.

Other South American planting material reached Malaya in 1951. *Hevea* seed obtained from Brazil and Peru came in transit through England and was handled by an officer of the Division who was in England on long leave at the time. The facilities of the Commonwealth Mycological Institute at Kew and of the Royal Botanic Gardens, Kew, were put at his disposal for the purpose of phytosanitary treatment and transhipment of this material.

The ungerminated seed were dispatched by air from South America to England. The first four consignments of seed were forwarded by air to Malaya, after disinfection, as ungerminated seed. These despatches were not entirely satisfactory. The seeds were therefore germinated at the Royal Botanic Gardens, Kew, and only germinated seeds were sent forward in subsequent consignments. These travelled without casualty. The despatch of *Hevea* seed in early stages of germination by air in pressurised aircraft has thus proved to be a practicable method. Out of these consignments 665 seedlings, known as the R.R.I. 1951 Seedling Collection, were well established by the end of 1951.

I(7) SELECTION OF CLONES AND SEEDLING FAMILIES BASED ON YIELD AND VEGETATIVE CHARACTERS

Legitimate Seedling Families of the Crosses made in 1937-41 and 1947-9

The results up to the end of 1950 of the breeding work carried out in the years 1937-41 and the yields and vegetative characters of the more important families of legitimate seedlings are described in detail in Communication 275 of the Journal, *Progress of Breeding Investigations with Hevea brasiliensis II.*[*]

* SHARP, C.C.T. *J. Rubb. Res. Inst. Malaya* 13 (1951) 73

*1937 Crosses: Field 33B, R.R.I. Experiment Station** — These legitimate seedlings were planted as two year old stumps in October 1939 and were brought into tapping on the half spiral alternate daily system (S/2.d.2.100%) in April 1946.

The data of yield for 1951 and of the mean annual yield for the period 1946-51 are given in TABLE V. The total brown bast incidence in each family during the same period is also given in this table.

Yields, brown bast incidence and girth measurements recorded to the end of 1950 have been reported previously.

In 1951 yields have been very much reduced by tapping on a new high panel but the order of merit amongst the families remains unchanged.

Over six years of tapping there would appear to be little difference in yield between the progeny of clone Tjir 1 and AVROS 157. Progeny of clone Pil B84 do not compare quite so well, though in the sixth year alone they have yielded as much per tree as the offspring of Tjir 1. Seedlings of clone AVROS 157 are more vigorous than either of the other two families, and appear to be less susceptible to brown bast. Seedlings of clone Pil B84 show a tendency to a higher rate of incidence of brown bast, and amongst the progeny of other clones used as parents, those of PB 24 and AVROS 33 also show this. The best families for yield, vigour and non-susceptibility to brown bast are Tjir 1 × PB 49 and AVROS 157 × PB 49. In these respects clone PB 49 is the outstanding parent of all those used.

1938 Crosses: Field 34A, R.R.I. Experiment Station† — The record of yield for 1951, the mean annual yield for the period 1946-51 and the total brown bast incidence for this period for each family are given in TABLE VI. Previous yields, brown bast incidences and girth measurements have been reported earlier.

Growth of the control buddings has been appreciably retarded as a result of the high stand which owing to the war was not thinned out until 1946. The low yield of these trees has had the effect of exaggerating the relative yields of the seedlings.

The progeny of Tjir 1 maintain an outstanding position for yield except for the cross Tjir 1 × Pil B84 which, since both clones are good seed parents in many other combinations, is unexpected. The seedlings of this cross are very well grown, but are poor in

* *Rep. Rubb. Res. Inst. Malaya* (1937) 108, (1939) 136, (1945-8) 46; Communication 275 *J. Rubb. Res. Inst. Malaya* 13 (1951) 73

† *Rep. Rubb. Res. Inst. Malaya* (1938) 92, (1940) 65, (1945-8) 49; Communication 275 *J. Rubb. Res. Inst. Malaya* 13 (1951) 73

TABLE V: LEGITIMATE SEEDLING CROSSES 1937

Planted October 1939. Tapped S/2.d/2.100% from April 1946

A: YIELDS

Compared with budded control Pil B84 as percentage

Parents	*Tjir 1*				*AVROS 157*				*Pil B84*				*Mean*	
	1951		*Mean 1946-51*		*1951*		*Mean 1946-51*		*1951*		*Mean 1946-51*		*1946-51*	
	lb/tree	%	*lb/tree/yr*	%	*lb/tree*	%	*lb/tree/yr*	%	*lb/tree*	%	*lb/tree/yr*	%	*lb/tree/yr*	%
PB 86	9.6	76	10.7	106	13.0	102	13.6	135	10.0	79	10.6	105	11.6	115
PB 24	21.3	168	18.6	184	18.4	145	15.8	156	18.4	145	15.3	151	16.6	109
PB 49	17.4	137	19.1	195	19.1	150	18.3	181	12.2	96	14.2	141	17.4	174
PB 186	16.4	129	14.4	143	–	–	–	–	17.4	137	14.5	144	14.5	95
AVROS 33	14.1	111	16.5	163	9.3	73	9.5	94	14.4	113	13.8	137	13.2	131
AVROS 157	16.6	131	15.4	152	–	–	–	–	21.8	172	18.4	182	16.9	112
Pil A44	–	–	–	–	10.2	80	10.9	108	–	–	–	–	10.9	108
Pil B84	5.3	42	9.8	97	21.8	172	18.4	182	–	–	–	–	14.1	140
Pil B58	10.6	83	12.3	120	–	–	–	–	–	–	–	–	12.3	125
Tjir 1	–	–	–	–	16.6	131	15.4	152	5.3	42	9.8	97	12.6	125
GI 1	12.0	94	11.3	112	13.5	106	12.0	119	9.8	77	10.8	107	11.4	113
BD 5	8.8	69	11.1	110	11.9	94	12.0	119	9.2	72	11.7	116	11.6	115
Mean	13.2		14.0		14.9		14.0		13.2		13.2		13.6	
Budded control, Pil B84									12.7		10.1			

Note: The third tapping panel on the seedling trees was opened at 40 inches from the ground in January 1951

TABLE V (*contd*)

B: BROWN BAST INCIDENCE 1946 TO 1951

Parents	*Tjir 1*			*AVROS 157*			*Pil B84*			*Total*		
	No of mature trees 1951	*BB cases 1946-51* No.	%	*No. of mature trees 1951*	*BB cases 1946-51* No.	%	*No. of mature trees*	*BB cases 1946-51* No.	%	*No. of mature trees 1951*	*BB cases 1946-51* No.	%
PB 86	62	17	27	55	13	24	29	12	41	146	42	29
PB 24	26	9	35	18	4	22	25	16	64	69	29	42
PB 49	45	9	20	49	3	6	38	9	24	132	21	16
PB 186	31	9	29	–	–	–	8	3	37	39	12	31
AVROS 33	30	10	33	3	2	67	4	4	100	37	16	43
AVROS 157	14	6	43	–	–	–	19	5	26	33	11	33
Pil A44	–	–	–	9	1	11	–	–	–	9	1	11
Pil B84	4	4	100	19	5	26	–	–	–	23	9	39
Pil B58	52	9	17	–	–	–	–	–	–	52	9	17
Tjir 1	–	–	–	14	6	43	4	0	0	18	6	33
Gl 1	28	6	21	16	1	6	6	1	17	50	8	16
BD 5	4	2	50	23	7	30	28	7	25	55	16	29
Total/Mean	296	81	27	206	42	20	161	57	35	663	183	28
Budded control, Pil B84										126	19	15

TABLE V (*contd*)

C: MEAN GIRTH IN INCHES AT 50 INCHES FROM THE GROUND 1950

Parents	*Tjir 1*	*AVROS 157*	*Pil B84*	*Mean*
PB 86	25.0	28.7	23.3	25.7
PB 24	29.5	28.5	27.1	28.4
PB 49	34.4	35.9	32.7	34.3
PB 186	28.9	–	29.4	29.1
AVROS 33	28.6	28.0	29.7	28.8
AVROS 157	30.8	–	36.7	33.7
Pil A44	–	28.4	–	28.4
Pil B84	23.4	36.7	–	30.0
Pil B58	27.2	–	–	27.2
Tjir 1	–	30.8	23.4	27.1
Gl 1	25.9	29.1	25.7	26.9
BD 5	23.0	26.9	25.5	25.1
Mean	27.7	30.3	28.2	28.7
Budded control, Pil B84				29.2

yield and are susceptible to brown bast. Seedlings of the cross RRIM 509 × Tjir 1, though recorded for only four trees, are the highest yielding. Brown bast incidence for the whole trial is very high.

*1939 Crosses: Field 38A, R.R.I. Experiment Station** — The record of yield for the period June 1950 to May 1951 the mean annual yield for the four years of tapping and the brown bast incidence for this period are given in TABLE VII.

The yields of family from Tjir 1 × Pil B84 confirm the disappointing results from this cross obtained from the 1937 and 1938 legitimate seedlings.

The crosses, Lun N × Tjir 1 and Lun N × RRIM 501 have given the best yields, but appear to be susceptible to brown bast.

1940 Crosses: Field 45A, R.R.I. Experiment Station† — The record of yield for the year May 1950 to April 1951, the mean annual yield for the three years of tapping and the brown bast incidence for this period are given in TABLE VIII. The best yields have been given by families Tjir 1 × RRIM 500, Tjir 1 × RRIM 523

* *Rep. Rubb. Res. Inst. Malaya* (1939) 132, (1941-5) 20, (1945-8) 49, Communication 275 *J. Rubb. Res. Inst. Malaya* 13 (1951)

† *Rep. Rubb. Res. Inst. Malaya* (1940) 64, (1941-5) 37, 91, Communication 275 *J. Rubb. Res. Inst. Malaya* 13 (1951)

and Pil B84 × RRIM 501, while results from Tjir 1 × RRIM 527 are disappointing. Brown bast incidence has been particularly high in families Tjir 1 × RRIM 500 and Tjir 1 × RRIM 529 and reflects the known susceptibility of clones RRIM 500 and RRIM 529.

*1941 Crosses: Field 45B, R.R.I. Experiment Station** — The record of yields for the first two years of tapping, the brown bast incidence and the girth in 1950 are given in TABLE IX.

The seedlings were brought into tapping in January 1950 and encouraging yields have been recorded from Tjir 1 × RRIM 509 (cf. performance of this family in the 1938 crosses, TABLE VI), RRIM 514 × RRIM 500, RRIM 514 × RRIM 506 and Tjir 1 × RRIM 500 (cf. this family in 1938 crosses in TABLE VI, and in the 1940 crosses, TABLE VIII).

A high brown bast incidence has been recorded in families Tjir 1 × RRIM 500, Tjir 1 × RRIM 506 and RRIM 514 × Pil B84.

1947 Crosses: Field 48B, R.R.I. Experiment Station† — Seedlings of this hand pollination programme were planted out in March - May 1950 as 2½ year old stumps. The families represented are as follows:

RRIM 501 × Tjir 1	108	seedlings
RRIM 501 × Pil B84	80	,,
RRIM 500 × Tjir 1	56	,,
RRIM 507 × Tjir 1	97	,,
RRIM 501 × RRIM 507	48	,,
Total	389	seedlings

The trial has a randomised layout with four replications of each seedling family and buddings of clone RRIM 501 used as control.

1948 Crosses: Field 51A, R.R.I. Experiment Station† — Seedlings of this hand pollination programme were planted out in November - December 1950, as two year old stumps. A randomised layout was employed with buddings of clone RRIM 501 for a control. The families in this trial are as follows:

33/103(RRIM 623) × Tjir 1		23	seedlings
,,	× RRIM 501	43	,,
,,	× Lun N	4	,,
33/129	× Tjir 1	4	,,
,,	× RRIM 501	41	,,

* *Rep. Rubb. Res. Inst. Malaya* (1941-5) 37, 91

† *Rep. Rubb. Res. Inst. Malaya* (1945-8) 40

33/129	×	32/599 (RRIM 600)	16	seedlings
,,	×	Lun N	2	,,
33/320	×	RRIM 501	26	,,
,,	×	RRIM 500	30	,,
32/599(RRIM 600)	×	Pil B84	22	,,
,,	×	RRIM 500	55	,,
,,	×	Lun N	23	,,
32/599(RRIM 600)	×	BR 2	8	,,
32/711	×	RRIM 501	37	,,
,,	×	RRIM 500	32	,,
44/550	×	RRIM 501	23	,,
,,	×	Lun N	9	,,
44/553	×	RRIM 501	45	,,
34/373	×	RRIM 500	16	,,

1949 Crosses: Field 52, R.R.I. Experiment Station — Seedlings of this hand pollination programme (page 6) were planted out as two year old stumps in November 1951 in a randomised layout with buddings of clone RRIM 501 as control. The families represented are:

RRIM 83	×	Tjir 1	28	seedlings
,,	×	RRIM 501	124	,,
,,	×	RRIM 509	31	,,
,,	×	RRIM 500	36	,,
,,	×	RRIM 507	48	,,
,,	×	Lun N	20	,,
44/533	×	Lun N	8	,,
32/599 (RRIM 600)	×	RRIM 501	68	,,
,,	×	Lun N	3	,,
34/162 (RRIM 610)	×	RRIM 500	32	,,

*Illegitimate Seedlings of Proved Clones**

Twentysix families of illegitimate seedlings of proved clones and the seedlings from a duoclone planting of Pil A44 and Pil B84 are represented in Fields 15A and 23A on the Experiment Station.

Yields for the years 1949, 1950 and 1951, and the mean annual yield for the period 1946-51 of the families in field 15A are given in TABLE X and of those in field 23A in TABLE XI. The two outstanding families for yield over the 6 years of tapping are the seedlings of clones TK 14 and BR I.

Incidence of brown bast is also shown in these tables. Seedlings of AVROS 186, AVROS 33, AVROS 52, PB 86 and S Reko 1 in these plantings are the most susceptible to the condition.

* *Rep. Rubb. Res. Inst. Malaya* (1936)74, (1945-8)51

Seedlings from Isolated Seed Garden

*Tjikadoe seedlings: Field 2, R.R.I. Experiment Station** — Yields of twentyfive small families of Tjikadoe seedlings from the seventh year of life (1935) to the twentythird year (1951), omitting the war years, are recorded in TABLE XII. The new tapping panel opened in January 1949 at 40 inches from the ground was on virgin bark above an earlier panel opened at 32 inches. This could explain the low yields recorded in 1949. During 1950 and 1951 tapping was on renewed bark and the yields recovered.

These seedlings were originally planted at the very low stand of 48 plants to the acre (30 ft × 40 ft) and when four years old were interplanted with unselected seedlings which were budded a year later. They have therefore had exceptionally good conditions for growth to develop high individual yields per tree.

Batu Kawan and Changkat seedlings† - Yields recorded from eight families of seedlings since resumption of tapping in 1946 after the war will be found in TABLE XIII. Seedlings of clones PB 25, AVROS 157, and PB 23 are the highest yielding. Seedlings of clones AVROS 49 and PB 186 form an intermediate group, while those of clones AVROS 256, BD 5 are inferior. The marked decline in yields recorded in 1951 is the result of tapping on a new panel.

Small Scale Clone Trials

Clones from estate mother trees: Field 15S, R.R.I. Experiment Station‡ - The yields of the best eighteen estate mother tree clones represented in the RRIM clone collection of 235 such clones are presented in TABLE XIV. All these clones except RRIM 147 have yielded appreciably more than the control clone AVROS 50. The highest yielding clones are RRIM 107, RRIM 142 and RRIM 229. It must be noted that AVROS 50 appears to be very unsuited to the sandy soil at Sungei Buloh. The clones marked with an asterisk in the table are being tested in large scale plantings on estates, the yields from which are quoted in TABLE XXI.

Clone collection: Field 15N, R.R.I. Experiment Station§ – The yields of four clones out of this collection of fiftyfive of the older

(page 35)

* *Rep. Rubb. Res. Inst. Malaya* (1928) 36, (1929) 47, (1935) 93, (1936) 70, (1937) 116, (1938) 98, (1939) 138, (1940) 66, (1941-5) 22,37, (1945-8) 56

† *Rep. Rubb. Res. Inst. Malaya* (1933)97, (1934)87, (1938)93, (1940)66, (1945-8)56

‡ *Rep. Rubb. Res. Inst. Malaya* (1931) 54, 70, (1932) 81, (1933) 95, (1937) 108, (1938) 90, (1939) 130, (1940) 64, (1945-8) 65

§ *Rep. Rubb. Res. Inst. Malaya* (1931) 54, 70, (1933) 95, (1937) 108, (1938) 90, (1939) 130, (1940) 64, (1941-5) 17, 36, (1945-8) 65

TABLE VI: YIELD AND BROWN BAST INCIDENCE

Planted October 1940. *Tapped*

Family	*No. of mature trees 1951*	*Yield for 1951*	
		lb	%
RRIM 500 × RRIM 501	8	10.9	99
RRIM 500 × RRIM 504	70	13.7	125
RRIM 500 × RRIM 509	1	22.4	204
RRIM 500 × RRIM 511	8	11.8	107
RRIM 500 × Tjir 1	10	25.5	232
RRIM 500 × Pil B84	1	6.0	55
RRIM 501 × RRIM 506	15	14.2	129
RRIM 501 × RRIM 509	6	7.8	71
RRIM 501 × RRIM 511	35	19.1	174
RRIM 501 × Tjir 1	27	20.2	184
RRIM 501 × Pil B84	12	17.8	162
RRIM 504 × RRIM 506	15	13.7	125
RRIM 504 × RRIM 509	38	11.4	104
RRIM 504 × RRIM 511	61	11.3	103
RRIM 504 × Tjir 1	66	19.0	173
RRIM 504 × Pil B84	24	13.4	122
RRIM 507 × Tjir 1	16	23.1	210
RRIM 509 × RRIM 511	7	7.9	72
RRIM 509 × Tjir 1	4	33.2	302
RRIM 511 × Tjir 1	12	15.9	145
RRIM 511 × Pil B84	6	20.0	182
Tjir 1 × Tjir 16	22	21.3	194
Tjir 1 × Pil B84	16	13.9	126
	480	16.2	147
Budded control Pil B84	109	11.0	100

Yield for 1951 *and the mean annual yield for the period* 1946 *to budded control Pil B84*

Note: *The third panel on the seedling trees was opened*

TABLE VII: YIELD AND BROWN BAST

Planted October 1941. *Tapped*

Family	*No. of mature trees 1951*	*Yield 1950-51*	
		lb	%
Lun N × Pil B84	5	18.6	207
Lun N × Tjir 1	5	19.0	211
Lun N × RRIM 501	24	12.9	143
Lun N × RRIM 500	17	14.9	166
BR 2 × RRIM 500	2	6.3	70
Tjir 1 × Pil B84	122	14.8	164
	175	14.4	160
Budded control Pil B84	53	9.0	100

Yield for the year 1950 *to* 1951 *and the mean annual yield for the percentage of the control*

Note: *The second tapping panel on the budded control*

OF LEGITIMATE SEEDLING CROSSES 1938

S/2.d/2.100% *from May* 1946

Mean yield 1946-51		*Brown bast 1946-51*		*Family*
lb	%	*cases*	%	
11.2	137	0	–	*RRIM 500 × RRIM 501*
13.2	161	43	61	*RRIM 500 × RRIM 504*
14.8	180	1	100	*RRIM 500 × RRIM 509*
12.4	151	8	100	*RRIM 500 × RRIM 511*
18.3	223	8	80	*RRIM 500 × Tjir 1*
4.0	49	1	100	*RRIM 500 × Pil B84*
10.3	126	15	100	*RRIM 501 × RRIM 506*
8.5	104	4	67	*RRIM 501 × RRIM 509*
16.9	206	19	54	*RRIM 501 × RRIM 511*
18.1	221	13	48	*RRIM 501 × Tjir 1*
18.9	230	12	100	*RRIM 501 × Pil B84*
12.0	146	8	53	*RRIM 504 × RRIM 506*
11.6	141	16	42	*RRIM 504 × RRIM 509*
12.1	148	29	48	*RRIM 504 × RRIM 511*
15.9	194	34	52	*RRIM 504 × Tjir 1*
11.9	145	9	38	*RRIM 504 × Pil B84*
19.0	232	13	81	*RRIM 507 × Tjir 1*
10.6	129	7	100	*RRIM 509 × RRIM 511*
26.8	326	1	25	*RRIM 509 × Tjir 1*
13.2	161	7	58	*RRIM 511 × Tjir 1*
18.4	224	2	33	*RRIM 511 × Pil B84*
19.0	232	12	55	*Tjir 1 × Tjir 16*
13.7	167	11	69	*Tjir 1 × Pil B84*
14.4	176	273	57	
8.2	100	13	12	*Budded control Pil B84*

1951 *in lb per tree per year and as percentage of the yield of the*

at 40 *inches from the ground in January* 1951

INCIDENCE OF LEGITIMATE SEEDLING CROSSES 1939

S/2.d/2.100% *from June* 1947

Mean annual yield for 1948-51		*Brown bast 1948-51*		*Family*
lb	%	*cases*	%	
14.2	197	1	20	*Lun N × Pil B84*
17.4	242	3	60	*Lun N × Tjir 1*
11.3	157	5	21	*Lun N × RRIM 501*
15.5	215	8	47	*Lun N × RRIM 500*
11.1	154	1	50	*BR 2 × RRIM 500*
12.3	171	52	43	*Tjir 1 × Pil B84*
13.6	189	70	40	
7.2	100	9	19	*Budded control Pil B84*

4 *years of tapping ending in* 1951 *in lb per tree per year and as*

was opened at 40 *inches from the union in January* 1951

TABLE VIII: YIELD AND BROWN BAST INCIDENCE

Planted November 1942. *Tapped*

Family	*No. of mature trees 1951*	*Yield 1950-51 lb*	*Mean yield 1948-51 lb*
Tjir 1 × Lun N	4	11.2	11.2
Tjir 1 × RRIM 500	6	17.3	18.5
Tjir 1 × RRIM 523	8	17.4	16.9
Tjir 1 × RRIM 524	15	12.9	11.6
Tjir 1 × RRIM 525	2	15.0	12.8
Tjir 1 × RRIM 526	18	15.6	12.8
Tjir 1 × RRIM 527	31	14.7	13.4
Tjir 1 × RRIM 528	30	15.3	13.8
Tjir 1 × RRIM 529	12	15.5	13.5
Pil B84 × RRIM 501	10	18.1	15.6
Pil B84 × RRIM 511	3	7.5	9.8
RRIM 500 × RRIM 501	2	16.9	13.6
BR 2 × Tjir 1	215	13.8	12.8
	356	14.7	13.5

Yield for 1950 *to* 1951 *and the mean annual yield for*

Note: *This trial contains*

TABLE IX: YIELD AND BROWN BAST INCIDENCE

Planted October 1943. *Tapped*

Family	*No. of mature trees*	*Yield per tree*		*Mean yield per year lb*
		1950 lb	*1951 lb*	
Tjir 1 × Lun N	6	6.6	14.1	10.3
Tjir 1 × RRIM 500	11	10.0	15.6	12.8
Tjir 1 × RRIM 506	21	9.3	14.1	11.7
Tjir 1 × RRIM 509	26	11.1	20.7	15.9
Tjir 1 × RRIM 512	4	6.4	12.9	9.6
Tjir 1 × RRIM 523	5	6.8	9.9	8.3
Tjir 1 × RRIM 524	3	3.7	8.9	6.3
Tjir 1 × RRIM 525	4	8.9	12.1	10.5
Lun N × RRIM 529	1	8.4	11.1	9.7
RRIM 505 × Lun N	19	5.5	9.2	7.3
RRIM 505 × Pil B84	10	5.7	10.9	8.3
RRIM 505 × RRIM 514	39	9.0	13.6	11.3
RRIM 514 × RRIM 500	13	13.5	17.0	15.2
RRIM 514 × RRIM 501	27	7.6	13.8	10.7
RRIM 514 × RRIM 506	21	10.8	16.0	13.4
RRIM 514 × Lun N	38	8.9	14.1	11.5
	248	8.3	13.4	10.8

Yields recorded for 1950 *and* 1951 *and the mean annual yield*

Note: *This trial contains*

OF LEGITIMATE SEEDLING CROSSES 1940

S/2.d/2.100% *from May*, 1948

Brown bast 1948-51		*Mean girth (in) at 50 inches from ground December 1950*	*Family*
cases	*%*		
0	–	18.7	*Tjir 1 × Lun N*
4	67	21.1	*Tjir 1 × RRIM 500*
1	12	21.5	*Tjir 1 × RRIM 523*
1	7	21.4	*Tjir 1 × RRIM 524*
0	–	19.6	*Tjir 1 × RRIM 525*
1	6	22.1	*Tjir 1 × RRIM 526*
5	16	21.0	*Tjir 1 × RRIM 527*
4	13	24.9	*Tjir 1 × RRIM 528*
4	33	23.5	*Tjir 1 × RRIM 529*
0	–	23.2	*Pil B84 × RRIM 501*
0	–	20.1	*Pil B84 × RRIM 511*
0	–	21.3	*RRIM 500 × RRIM 501*
22	10	22.3	*BR 2 × Tjir 1*
42	12	21.6	

the three years of tapping in lb per tree per year
no budded control

OF LEGITIMATE SEEDLING CROSSES 1941

S/2.d/2.100% *from January* 1950

Brown bast 1950-51		*Mean girth (in) at 50 inches from ground December 1950*	*Family*
cases	*%*		
0	–	19.5	*Tjir 1 × Lun N*
2	18	17.4	*Tjir 1 × RRIM 500*
2	10	18.6	*Tjir 1 × RRIM 506*
0	–	20.5	*Tjir 1 × RRIM 509*
0	–	15.5	*Tjir 1 × RRIM 512*
0	–	17.7	*Tjir 1 × RRIM 523*
0	–	16.2	*Tjir 1 × RRIM 524*
0	–	18.5	*Tjir 1 × RRIM 525*
0	–	17.6	*Lun N × RRIM 529*
0	–	17.7	*RRIM 505 × Lun N*
1	10	21.0	*RRIM 505 × Pil B84*
1	3	20.9	*RRIM 505 × RRIM 514*
1	8	20.9	*RRIM 514 × RRIM 500*
1	4	18.9	*RRIM 514 × RRIM 501*
0	–	19.7	*RRIM 514 × RRIM 506*
0	–	20.7	*RRIM 514 × Lun N*
8	3	18.8	

for the two years of tapping expressed as lb per tree per year
no budded control

TABLE X: YIELD AND BROWN BAST INCIDENCE

Field 15A R.R.I. Experiment Station Planted November

Field	Family	No. of mature trees 1951	1949 lb	1949 %	1950 lb	1950 %
	Pil B16	19	10.6	110	10.0	78
	Waring 1	25	11.9	134	12.2	95
	Lamp 2	20	14.4	150	12.3	96
	TK 14	22	17.6	183	13.9	109
15A	*RA 20*	29	11.3	118	10.5	82
North	*BR 1*	31	16.1	168	16.4	128
east	*TK 26*	17	12.2	127	14.7	115
section	*Budded control, Pil B84*	21	9.6	100	12.8	100
	TK 12	82	14.7	121	12.2	83
	BD 7	80	14.9	123	13.1	89
	SR 1	56	12.0	99	11.6	79
	SR 2	88	13.6	112	12.4	84
	Budded control, Pil B84	95	12.1	100	14.7	100
15A	*Rub 393*	55	15.4	126	16.2	105
North	*AVROS 183*	39	11.7	96	10.4	67
section	*Pil B84*	49	16.2	133	17.0	110
	Budded control, Pil B84	45	12.2	100	15.5	100

Yields and mean annual yield for 1946 *to* 1951 *expressed*

TABLE XI: YIELD AND BROWN BAST INCIDENCE

Field 23A R.R.I. Experiment Station Planted November

Field	Family	No. of mature trees 1951	1949 lb	1949 %	1950 lb	1950 %
	PB 186	8	14.9	123	17.4	137
	AVROS 33	5	11.1	78	10.9	86
	PB 123	18	18.4	129	16.6	131
	Budded control, Pil B84	10	14.3	100	12.7	100
23A	*PB 86*	71	14.9	141	15.0	138
West	*AVROS 185*	64	12.4	117	13.6	125
section	*PB 49*	71	13.2	125	13.8	127
	BD 5	64	12.8	121	13.2	121
	Tjir 16	77	10.6	100	11.5	106
	Gl 1	68	13.2	125	16.0	147
	AVROS 52	69	11.8	111	12.4	114
	BD 10	78	11.3	107	11.6	106
	Ct 88	74	10.8	102	11.4	105
	Budded control, Pil B84	57	10.6	100	10.9	100
23A	*Pil A44 × Pil B84*	178	11.7	56	11.7	61
South						
section	*Budded control, PB 186*	22	21.0	100	12.7	100

Yields and mean annual yield for 1946 *to* 1951 *expressed*

OF ILLEGITIMATE SEEDLING FAMILIES OF PROVED CLONES
1936. *Tapped* S/2.d/2.100% *from May* 1946

1951		*Mean 1946-51*		*Brown bast 1946-51*		*Family*
lb	%	*lb*	%	*cases*	%	
10.2	81	12.0	103	4	21	*Pil B16*
13.9	110	13.2	114	–	–	*Waring 1*
13.8	110	14.3	123	2	10	*Lamp 2*
16.3	129	19.1	165	3	14	*TK 14*
11.3	90	12.8	110	4	14	*RA 20*
15.3	121	17.4	150	4	13	*BR 1*
14.8	118	13.1	113	2	12	*TK 26*
12.6	100	11.6	100	2	10	*Budded control, Pil B84*
11.7	78	15.0	104	18	22	*TK 12*
12.8	85	14.9	104	5	6	*BD 7*
12.4	83	13.5	94	17	30	*SR 1*
11.8	79	15.6	108	14	16	*SR 2*
15.0	100	14.4	100	7	7	*Budded control, Pil B84*
14.9	92	16.4	105	10	18	*Rub 393*
8.9	55	13.8	91	18	46	*AVROS 183*
17.5	108	18.7	123	13	26	*Pil B84*
16.2	100	15.2	100	6	13	*Budded control, Pil B84*

as lb per tree per year and as percentage of control

OF ILLEGITIMATE SEEDLING FAMILIES OF PROVED CLONES
1936. *Tapped* S/2.d/2.100% *from May* 1946

1951		*Mean 1946-51*		*Brown bast 1946-51*		*Family*
lb	%	*lb*	%	*cases*	%	
17.9	142	15.8	114	1	13	*PB 186*
14.6	116	14.7	106	2	40	*AVROS 33*
17.6	140	17.7	127	4	22	*PB 123*
12.6	100	13.9	100	–	–	*Budded control, Pil B84*
15.2	139	15.1	131	24	34	*PB 86*
12.4	114	12.3	107	16	25	*AVROS 185*
14.6	134	14.3	124	16	23	*PB 49*
13.5	124	12.9	112	13	20	*BD 5*
12.3	113	10.9	95	13	17	*Tjir 16*
15.9	146	13.9	121	18	26	*Gl 1*
12.1	111	13.5	117	25	36	*AVROS 52*
11.8	108	12.0	104	8	10	*BD 10*
12.1	111	11.4	99	13	18	*Ct 88*
10.9	100	11.5	100	13	23	*Budded control, Pil B84*
12.0	68	12.4	67	24	13	*Pil A44 × Pil B84*
17.7	100	18.4	100	5	23	*Budded control, PB 186*

as lb per tree per year and as percentage of control

TABLE XII: YIELD OF SEEDLING FROM TJIKADOE ISOLATION SEED GARDEN

Field 2 R.R.I. Experiment Station. Planted October 1928

Tapping system S/2.d/2.100%

Family	*Trees tapped 1951*	*Yield in pounds per tree per annum*											*Brown bast cases 1951*
		1935	*1936*	*1937*	*1938*	*1939*	*1940*	*1946*	*1947*	*1948*	*1949*	*1950*	*1951*	
1	9	6.6	10.5	12.2	13.6	20.2	23.9	30.2	38.2	27.9	23.9	27.2	27.6	–
2	12	7.0	11.6	14.4	20.4	24.9	24.5	29.0	34.2	32.6	20.4	22.4	25.1	–
3	8	4.0	7.2	8.5	13.0	15.9	17.4	15.2	20.0	18.6	12.6	18.0	21.4	5
4	7	3.2	5.2	7.3	10.0	13.5	15.1	19.6	24.1	21.5	15.2	17.0	21.3	2
5	12	2.9	5.1	4.6	6.7	9.4	11.3	14.9	24.5	21.5	12.1	13.8	16.3	–
6	8	6.3	9.1	12.3	19.1	21.6	19.1	24.3	30.6	32.6	18.4	21.5	27.8	1
7	11	6.5	12.2	14.4	20.2	24.6	29.5	22.0	31.4	34.9	19.1	26.5	30.9	–
8	11	3.7	6.2	7.8	10.4	13.1	14.4	22.4	26.3	24.6	18.1	18.9	20.7	–
9	4	5.4	9.6	14.1	20.8	27.8	28.4	25.6	47.7	38.6	12.6	20.1	25.6	1
10	7	9.6	17.4	15.5	16.6	26.3	35.3	32.7	47.6	40.6	25.6	34.7	38.4	–
11	7	3.4	6.6	6.5	4.5	12.0	16.8	11.0	17.2	16.4	7.9	10.3	13.3	–
12	7	4.5	9.0	9.5	14.5	22.7	19.8	24.5	32.0	33.3	19.7	25.3	27.8	–

13	4	5.5	5.8	6.7	11.0	14.5	14.5	15.9	19.9	21.3	11.4	17.3	18.2	2
14	3	4.1	9.4	11.9	18.7	21.9	23.1	30.5	36.6	33.4	15.7	27.4	33.4	1
15	8	7.0	11.1	14.3	20.4	28.6	25.9	24.7	42.2	40.6	18.5	30.7	32.8	5
16	6	3.6	4.7	7.0	8.8	10.5	11.7	12.1	26.0	29.5	14.4	15.6	17.5	2
17	7	8.4	12.2	21.7	26.4	29.4	33.4	31.1	64.3	53.1	24.2	32.4	38.2	1
18	11	4.3	7.2	9.2	13.2	15.0	15.0	19.4	27.0	26.3	15.1	21.1	18.9	2
19	11	4.0	7.1	8.6	11.8	17.8	17.8	17.8	26.3	25.8	12.6	21.0	23.8	–
20	9	9.2	16.8	18.4	23.7	32.9	32.2	26.7	34.0	34.8	23.4	27.8	32.8	3
21	6	11.3	9.6	12.0	15.8	23.2	23.7	32.6	45.8	38.9	25.7	31.9	32.1	–
22	6	5.6	10.8	14.0	24.8	29.6	25.0	29.7	49.1	37.7	22.9	32.9	36.6	1
23	7	5.2	7.7	9.4	14.0	16.2	21.0	23.0	36.3	30.6	13.6	20.6	24.8	–
24	11	5.5	8.7	11.5	16.3	20.9	24.6	19.6	31.1	30.6	19.9	26.7	27.7	–
25	6	3.1	3.7	5.2	10.0	15.1	16.2	18.8	30.0	29.7	15.7	20.5	27.1	2
All families	198	5.5	9.0	11.1	15.4	20.3	21.6	22.9	33.7	31.0	*17.5	23.3	26.4	–

* *New cuts opened at* 40 *in from ground level in Jan* 1949

TABLE XIII: YIELD OF SEEDLINGS FROM ISOLATED SEED GARDENS

Field 20A R.R.I. Experiment Station

Family	*Origin*	*No. of trees tapped 1951*	*Yield in lb/tree/year (160 tappings)*							*Incidence of brown bast 1946-51*
			*1946**	*1947*	*1948*	*1949*	*1950*	*1951†*	*Mean 1946-51*	
AVROS 157	*B. Kawan*	39	12.1	20.1	18.4	21.9	22.2	14.8	19.8	9
PB 25	*B. Kawan*	41	22.2	20.1	21.0	22.4	19.5	15.7	20.2	9
BD 5	*B. Kawan*	42	16.1	14.3	13.4	13.6	11.8	8.4	12.9	11
PB 186	*B. Kawan*	35	15.9	16.4	15.9	18.4	17.6	12.7	16.2	7
AVROS 256	*B. Kawan*	42	15.1	13.7	14.0	15.3	15.6	9.3	13.8	7
AVROS 49	*B. Kawan*	42	21.1	18.8	19.0	17.9	17.2	13.1	17.8	9
PB 23	*B. Kawan*	32	21.2	19.3	20.0	20.9	12.0	12.8	18.5	10
Sab 24	*Changkat*	43	13.1	12.6	12.8	12.7	12.7	9.1	12.2	8

Planted November 1933

Tapped S/2.d/2.100%

* *Yields for* 1946 *estimated from yields for the period June to November* 1946

† *New panel opened at* 40 *inches from the ground in January* 1951

TABLE XIV: CLONES FROM ESTATE MOTHER TREES AND CLONE COLLECTION

Field 15 R.R.I. Experiment Station Budded 1931 to 1933

Yield in pounds per tree per year (160 *tappings*) *on* S/2.d/2.100% *system*

Clone	*1949*			*1950*			*1951*			*Mean annual recorded yield 1937-51*		
	Clone	*Control*	%	*Clone*	*Control*	%	*Clone*	*Control*	%	*Clone*	*Control*	%
*RRIM 5**	21.5	6.5	331	23.0	6.9	333	25.5	9.6	266	16.8	7.4	227
*RRIM 27**	14.3	4.6	311	18.4	5.8	317	14.3	8.1	176	13.4	6.2	216
*RRIM 49**	17.4	7.7	226	17.7	10.5	169	15.0	12.3	122	14.1	8.5	166
RRIM 71	32.9	9.2	358	23.6	12.8	184	17.2	14.1	122	21.4	9.9	216
RRIM 88	18.0	7.4	243	20.8	10.6	196	23.3	13.8	169	15.3	8.0	191
*RRIM 99**	20.3	11.6	175	20.6	14.1	146	21.7	18.0	121	15.7	10.3	152
RRIM 103	18.5	7.6	243	19.3	8.4	230	20.3	11.4	178	15.2	7.9	197
*RRIM 107**	24.9	8.4	296	24.2	10.4	233	27.3	16.6	164	19.9	7.7	258
RRIM 121	18.9	6.8	278	22.8	7.9	289	25.1	8.7	289	14.9	7.1	210
*RRIM 138**	17.5	9.2	190	23.4	8.1	289	22.2	10.2	218	14.6	7.6	192
*RRIM 142**	29.8	6.6	452	27.7	8.4	330	21.7	9.7	224	20.0	8.1	247
*RRIM 147**	9.2	12.9	71	11.0	15.1	73	9.1	16.0	57	10.4	10.7	97
*RRIM 178**	19.4	7.0	277	18.9	9.2	205	16.2	10.7	151	15.1	6.5	232
*RRIM 195**	16.8	6.8	247	16.8	8.0	210	17.1	11.3	151	13.8	7.3	189
RRIM 211	23.8	8.2	290	26.8	9.3	288	21.4	10.0	214	19.0	8.1	235
RRIM 218	19.9	6.9	288	20.1	10.1	199	17.2	13.9	124	16.4	8.6	191
RRIM 221	21.6	10.7	202	23.3	14.3	163	22.3	16.8	133	16.5	9.8	168
RRIM 229	27.6	6.0	460	24.3	8.1	300	18.0	10.7	168	18.9	7.5	252
Lun N	21.1	8.0	264	17.7	11.4	155	14.9	11.7	127	14.1	7.5	188
PB 49	31.0	6.8	456	30.5	7.9	386	29.1	10.0	291	19.0	6.6	288
PB 123	27.2	14.4	189	21.2	17.9	118	14.9	17.1	87	16.7	10.0	167
PB 86	13.7	13.8	99	15.9	16.6	96	14.8	16.5	90	12.1	9.6	127

* *These clones are being tested on a large scale in estate trials*

Control clone is AVROS 50

TABLE XV: YIELD OF A SELECTION OF CLONES MADE FROM *Fields 32 and 33 R.R.I.*

Clone	*Field*	*Parentage of mother tree*	*Year budded*	*No. of trees*
RRIM 600	32	*Tjir 1 × PB 86*	1939	7
Control				
RRIM 601	32	*Tjir 1 × Gl 1*	1939	6
Control				
RRIM 602	32	*Tjir 1 × Gl 1*	1939	7
Control				
RRIM 603	33	*PB 86 × Pil B84*	1939	7
Control				
RRIM 604	32	*Tjir 1 × PB 49*	1939	7
Control				
RRIM 605	32	*Tjir 1 × PB 49*	1939	7
Control				
RRIM 606	32	*Tjir 1 × PB 49*	1939	7
Control				
RRIM 607	32	*Tjir 1 × PB 49*	1939	6
Control				
RRIM 608	32	*AVROS 33 × Tjir 1*	1939	7
Control				
RRIM 609	33	*AVROS 157 × BD 5*	1939	6
Control				
RRIM 612	33	*AVROS 157 × PB 49*	1939	6
Control				
RRIM 623	33	*PB 49 × Pil B84*	1939	6
Control				

Tapped S/2.d/2.100%

TABLE XVI: YIELD OF A SELECTION OF CLONES MADE FROM *Fields 34 and 44 R.R.I.*

Clone	*Field*	*Parentage of mother tree*	*Year budded*	*No. of trees*
RRIM 610	34	*RRIM 504 × Tjir 1*	1940	7
Control				
RRIM 611	34	*RRIM 504 × Tjir 1*	1940	5
Control				
RRIM 613	34	*Tjir 1 × RRIM 509*	1939	6
Control				
RRIM 614	34	*Tjir 1 × RRIM 509*	1939	4
Control				
RRIM 615	44	*RRIM 511 × Tjir 1*	1939	7
Control				
RRIM 616	44	*Tjir 1 × RRIM 507*	1939	7
Control				
RRIM 619	34	*RRIM 501 × Tjir 1*	1940	6
Control				
RRIM 620	34	*RRIM 501 × RRIM 511*	1940	7
Control				
RRIM 621	34	*RRIM 504 × Tjir 1*	1940	7
Control				

Tapped S/2.d/2.100%

THE LEGITIMATE SEEDLINGS OF THE 1937 CROSSES

Experiment Station

Yield in lb/tree/year					*Av. girth in inches Feb 1952*	*B. bast 1947-51*	*Clone*
1947	*1948*	*1949*	*1950*	*1951*			
20.5	24.4	23.2	26.8	27.9	31.9	2	*RRIM 600*
8.1	8.2	9.0	9.9	11.9			*Control*
10.5	16.2	16.3	16.4	24.7	34.7	1	*RRIM 601*
3.8	5.0	5.3	5.0	6.7			*Control*
13.2	17.7	20.8	20.9	18.3	33.5	–	*RRIM 602*
4.8	5.2	3.8	4.9	5.8			*Control*
14.6	17.3	18.1	21.2	21.4	37.3	1	*RRIM 603*
7.9	6.9	6.7	9.1	8.0			*Control*
15.3	18.0	20.1	22.2	22.8	37.4	2	*RRIM 604*
4.9	4.7	4.9	5.1	4.8			*Control*
17.3	25.8	27.1	19.5	24.7	30.9	1	*RRIM 605*
4.9	4.7	4.2	5.1	4.8			*Control*
11.6	15.7	21.6	22.9	19.0	34.3	1	*RRIM 606*
3.2	2.8	1.7	3.6	2.5			*Control*
15.2	18.8	21.3	20.5	19.9	36.9	1	*RRIM 607*
4.9	4.7	4.9	5.1	4.8			*Control*
9.6	17.5	18.6	18.1	26.2	31.5	1	*RRIM 608*
4.9	6.0	4.3	5.3	6.1			*Control*
9.5	14.3	15.5	13.2	21.9	31.5	1	*RRIM 609*
5.6	4.8	4.8	6.9	7.4			*Control*
11.4	11.4	17.1	17.6	20.7	39.9	–	*RRIM 612*
7.3	3.9	5.3	5.0	6.1			*Control*
23.0	20.5	22.3	19.4	25.5	37.3	1	*RRIM 623*
7.3	7.3	8.7	10.3	9.7			*Control*

Control Clone Pil B84

THE LEGITIMATE SEEDLINGS OF THE 1938 CROSSES

Experiment Station

Yield in lb/tree/year					*Av. girth in inches Feb 1952*	*B. bast 1947-51*	*Clone*
1947	*1948*	*1949*	*1950*	*1951*			
14.1	19.7	21.0	18.2	32.9	32.4	–	*RRIM 610*
6.9	8.7	7.8	6.1	8.4			*Control*
13.8	18.3	21.8	22.6	31.2	29.6	1	*RRIM 611*
5.5	7.5	8.6	8.6	10.4			*Control*
12.0	18.0	18.3	14.4	16.5	28.4	1	*RRIM 613*
4.0	5.7	6.2	6.5	7.8			*Control*
16.5	21.0	24.3	17.1	22.5	28.5	1	*RRIM 614*
3.8	5.7	4.6	4.4	4.8			*Control*
10.2	17.8	20.2	21.5	19.8	31.8	1	*RRIM 615*
7.5	11.2	11.5	11.4	12.9			*Control*
14.3	17.8	22.2	25.3	24.3	29.5	–	*RRIM 616*
5.3	7.0	9.1	9.8	8.9			*Control*
11.1	15.4	21.5	14.7	16.7	26.4	–	*RRIM 619*
4.7	7.1	8.5	8.5	7.7			*Control*
7.1	16.2	21.5	16.9	23.2	33.6	–	*RRIM 620*
6.3	9.8	10.8	9.3	9.5			*Control*
7.6	11.2	20.7	17.2	21.2	28.2	–	*RRIM 621*
3.0	3.6	3.6	3.7	4.5			*Control*

Control Clone Pil B84

TABLE XVII: YIELD OF A SELECTION OF CLONES MADE FROM THE LEGITIMATE SEEDLINGS OF THE 1939 CROSSES

Field 38 R.R.I. Experiment Station

Clone	*Field*	*Parentage of mother tree*	*No. of trees*	*Yield in lb/tree/year*				*Av. girth in inches Feb 1952*	*B. bast 1947-51*
				1948	*1949*	*1950*	*1951*		
RRIM 617	38	*BR 2 × RRIM 500*	6	13.8	14.1	13.7	17.9	29.7	–
Control				4.8	5.4	7.6	10.8		
RRIM 618	38	*Lun N × RRIM 501*	6	15.2	21.3	21.6	20.8	31.1	–
Control				6.7	8.6	10.7	12.2		
RRIM 622	38	*Tjir 1 × Pil B84*	5	14.9	22.6	20.5	21.6	32.0	2
Control				7.4	9.5	8.9	12.6		

Budded 1941 Tapped S/2.d/2.100%

Control clone is Pil B84

clones from Malaya, Java and Sumatra are given in TABLE XIV. The layout is the same as for the estate mother tree clones beside which they are planted. Although PB 49 is considered to be a second grade clone its yield has been outstanding. The performance of PB 86, an acknowledged superior clone, has been most disappointing under the conditions of the trial. The very light sandy soil and competition may be responsible.

Clones from 1937[1]*, 1938*[2]*, 1939*[3] *and 1940*[4] *hand pollinated seedlings* – The yields of the RRIM '600' series clones represented in small scale trials are given in TABLES XV to XVIII.

Clones from 1940[4] *and 1941*[5] *hand pollinated seedlings* — During the first quarter, 1951, clones were made from the balance of the 1940 hand pollinated seedlings which were not made into clones in 1942, and from the 1941 hand pollinated seedlings none of which had had clones made from them when planted out in the field. These clones were established in two small scale trials in Field 49, R.R.I. Experiment Station, with buddings of RRIM 501 for a control.

Clones from 1947 hand pollinated seedlings[6] – Between March and May 1950, 344 new clones were made from these seedlings. Budding was carried out in Field 48B, R.R.I. Experiment Station with clone RRIM 501 for a control. Termites have taken considerable toll of many of the clones and supplying by disbudding has had to be resorted to.

Clones from 1948 hand pollinated seedlings[6] — In the first quarter of 1951, 412 new clones were made from these seedlings. Budding was carried out in Field 48D, R.R.I. Experiment Station with clone RRIM 501 for a control.

Clones from 1949 hand pollinated seedlings — During the last quarter of 1951, budding of 342 clones made from these seedlings (page 20) was carried out in Field 49, R.R.I. Experiment Station with clone RRIM 501 for a control. Cutting back of the stocks of successful buddings had not been carried out before the end of the period covered by this report.

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1 *Rep. Rubb. Res. Inst. Malaya* (1937) 108, (1939) 136, (1945-8) 65; Communication 275 *J Rubb. Res. Inst. Malaya* 13 (1951)

2 *Rep. Rubb. Res. Inst. Malaya* (1938) 92, (1940) 65, (1945-8) 65; Communication 275 *J. Rubb. Res. Inst. Malaya* 13, (1951)

3 *Rep. Rubb. Res. Inst. Malaya* (1939) 132, (1941-5) 20; Communication 275, *J. Rubb. Res. Inst. Malaya* 13, (1951)

4 *Rep. Rubb. Res. Inst. Malaya* (1940) 64, (1941-5) 37; Communication 275 *J. Rubb. Res. Inst. Malaya* 13, (1951)

5 *Rep. Rubb. Res. Inst. Malaya* (1941-5) 37; Communication 275, *J. Rubb. Res. Inst. Malaya* 13, (1951)

6 *Rep. Rubb. Res. Inst. Malaya* (1945-8) 40

TABLE XVIII: YIELD OF A SELECTION OF CLONES MADE FROM THE LEGITIMATE SEEDLINGS OF THE 1940 CROSSES

Fields 41 and 42 R.R.I. Experiment Station

Clone	*Field*	*Parentage of mother tree*	*No. of trees*	*Yield in lb/tree/anum*		*Av. girth (in) Feb 1952*
				1949-50	*1950-51*	
RRIM 624	42	*Tjir 1 × RRIM 529*	7	14.1	–	
Control				5.0		*Trees*
RRIM 625	42	*Tjir 1 × RRIM 526*	7	17.6	–	
Control				4.8		*slashed*
RRIM 626	42	*Tjir 1 × RRIM 500*	6	14.7		
Control				4.3		*by*
RRIM 627	42	*Tjir 1 × RRIM 526*	6	12.0	–	
Control				4.8		*terrorists*
RRIM 628	41	*Tjir 1 × RRIM 527*	7	14.5	13.6	
Control				5.2	4.1	20.5
RRIM 629	41	*Tjir 1 × RRIM 529*	7	14.1	13.6	
Control				7.3	7.2	23.5
RRIM 630	41	*Tjir 1 × RRIM 527*	7	10.8	9.1	
Control				6.1	5.8	23.0

Budded 1942 *Tapped* S/2.d/2.100% *Control clone in Pil B84*

TABLE XIX: YIELDS OF BUDDED TREES

Field 5 R.R.I. Experiment Station

Clone	*Trees tappable 1951*	*Yield in pounds per tree per year (160 tappings)*							*Tappable trees with b. bast %*					
		Mean 1936-40	*1946*	*1947*	*1948*	*1949*	*1950*	*1951*	*Mean 1946-51*	*1946*	*1947*	*1948*	*1949*	*1950*	*1951*
AVROS 49	294	8.0	13.1	15.3	15.6	10.7	13.3	13.5	13.6	1.4	0.7	1.4	0.3	0.3	1.0
AVROS 50	289	8.1	10.6	14.4	15.1	8.2	10.3	13.7	12.0	0.7	0.4	0.4	0.7	1.0	1.7
AVROS 152	289	5.7	10.2	13.4	13.6	9.1	9.9	12.1	11.4	0.7	0.7	2.1	1.3	1.4	0.7
BD 5	280	6.3	12.9	14.6	12.9	10.5	11.9	14.3	12.8	0.4	1.8	1.5	0.4	0.4	1.8
Pil A44	249	9.4	14.3	16.9	16.4	11.7	12.8	14.6	14.4	0.8	1.2	2.4	2.3	0.8	0
Pil B84	262	9.0	16.1	21.1	19.0	12.8	13.6	15.7	16.4	0.7	3.3	2.7	1.8	3.6	0.4
PB 23	265	8.5	13.7	17.9	20.7	9.9	11.1	14.0	14.6	0	1.2	2.0	0	0	1.1
PB 186	263	8.9	16.1	21.9	19.8	15.9	15.9	16.5	17.7	0.8	1.5	2.3	1.9	0.4	2.3
Tjir 1	259	11.5	13.9	21.2	20.4	13.1	14.3	17.1	16.7	0.7	2.6	3.5	1.5	1.5	1.9

Planted as budded stumps November 1929. *Tapped* S/2.d/2.100%.

Tapping from 1946 *has been on bark of first renewal.*

A new panel was opened in Jan 1949 *at* 40 *inches from union.*

Standard clone trials

Estate No.	*9 Inland soil*						*16 Inland soil*						
Age from budding (years)	*9*		*10*		*11*		*9*		*10*		*11*		*12*
Clones	*lb/ac*	*%*	*lb/ac*	*%*	*lb/ac*	*%*	*lb/ac*	*%*	*lb/ac*	*%*	*lb/ac*	*%*	*lb/ac*
Pil B84	--	100	670	100	693	100	668	100	728	100	323	100	799
Pil D65	-	89	638	95	643	93	651	98	718	99	824	100	714
PB 186	-	–	–	–	–	–	–	–	–	–	–	–	–
Gl 1		133	845	126	782	113	–	–	–	–	–	–	–
PB 86		131	897	134	963	139	925	139	967	133	1039	126	1038
BD 5		–	–	–	–	–	–	–	–	–	–	–	–
Tjir 1	-	132	804	120	1005	145	908	136	789	108	960	117	1004
Tjir 16	-	–	–	–	–	–	928	139	1123	154	1169	142	987
Tapping system	S/2.d/2.100%						S/2.d/2.100%						

* *Tapping system altered to* S/3.d/2.67% fr

Subsidiary clone trials

Estate No.	*9 Inland soil*						*16 Inland soil*			
Age from budding (years)	*9*		*10*		*11*		*10*	*11*	*12*	*1.*
Clones	*lb/tree*	*%*	*lb/acre*	*%*	*lb/acre*	*%*	*lb/tree*	*lb/tree*	*lb/tree*	*lb/t*
Pil B84	6.0	100	670	100	693	100	–	–	–	–
Tjir 1	–	–	–	–	–	–	–	–	–	–
Tjir 16	7.5	125	952	142	1058	153	–	–	–	–
Sab 24	–	–	–	–	–	–	8.4	9.8	10.4	14.
Rub 393	5.3	88	773	115	879	127	8.8	9.4	9.7	13.
PB 186	–	–	–	–	–	–	9.0	10.8	10.7	12.
BD 5	4.5	75	634	95	478	69	7.5	8.2	8.2	10.
Gl 1	6.8	113	803	120	719	104	12.7	12.6	10.8	13.
Lun N	5.2	87	732	109	824	119	–	–	–	–
Tapping system	S/2.d/2.100%						S/2.d/2.100%			

Standard clone trials

28 Coastal soil								*41 Coastal soil*								*Estate No.*
9		*10*		*11*		*12*		*11*		*12*		*13*				*Age from budding (years)*
ac	*%*	*lb/ac*	*%*	*lb/ac*	*%*	*lb/ac*	*%*	*lb/ac*	*%*	*lb/ac*	*%*	*lb/ac*	*%*			*Clones*
100		561	100	671	100	602	100	755	100	654	100	781	100			*Pil B84*
108		570	102	681	101	613	102	795	100	675	103	792	101			*Pil D65*
86		537	96	668	100	641	106	842	112	661	101	807	103			*PB 186*
197		896	160	897	134	785	130	1614	214	1093	167	895*	115			*Gl 1*
161		850	152	828	123	850	141	1054	140	914	140	1115	143			*PB 86*
65		360	64	485	72	504	84	601	80	523	80	654	84			*BD 5*
–		–	–	–	–	–	–	–	–	–	–	–	–			*Tjir 1*
		–	–	–	–	–	–	–	–	–	–	–	–			*Tjir 16*
S/2.d/2.100%								S/2.d/2.100%								*Tapping system*

fourth month owing to high incidence of brown bast.

Subsidiary clone trials

28 Coastal soil			*41 Coastal soil*						*Estate No.*
10	*11*	*12*	*11*		*12*		*13*		*Age from budding (years)*
tree	*lb/tree*	*lb/ac*	*lb/ac*	*%*	*lb/ac*	*%*	*lb/ac*	*%*	*Clones*
–	–	–	755	100	654	100	781	100	*Pil B84*
5.9	7.5	943	918	122	690	106	977	125	*Tjir 1*
5.9	5.7	733	1027	136	799	122	973	125	*Tjir 16*
5.5	7.3	958	897	119	789	121	1045	134	*Sab 24*
4.5	5.9	757	621	82	708	108	787	101	*Rub 393*
–	–	–	–	–	–	–	–	–	*PB 186*
–	–	–	–	–	–	–	–	–	*BD 5*
–	–	–	–	–	–	–	–	–	*Gl 1*
–	–	–	–	–			–	–	*Lun N*
S/2.d/2.100%			S/2.d/2.100%						*Tapping system*

TABLE XXI: YIELD OF CLONES FROM ESTATE MOTHER
ACRE PER YEAR AND

Estate	*175*							
Age in years	8		9		10		11	
Year of recording	1		2		3		4	
Clones	*lb/ac*	%	*lb/ac*	%	*lb/ac*	%	*lb/ac*	%
Pil B84	395	100	615	100	816	100	992	100
RRIM 5	382	97	628	105	1035	159	1298	131
RRIM 27	–	–	–	–	–	–	–	–
RRIM 49	–	–	–	–	–	–	–	–
RRIM 99	–	–	–	–	–	–	–	–
RRIM 107	–	–	–	–	–	–	–	–
RRIM 138	444	113	667	108	920	113	1048	106
RRIM 142	444	113	695	113	1002	123	943	95
RRIM 147	–	–	–	–	–	–	–	–
RRIM 178	412	104	584	95	868	106	931	94
RRIM 195	430	109	588	96	836	102	941	95
RRIM 218	345	87	505	82	758	93	923	93
Tapping system	S/2.d/2.100%							

TABLE XXI: (*cont.*)

Estate	*122*					
Age in years	9		10		11	
Year of recording	1		2		3	
Clones	*lb/ac*	%	*lb/ac*	%	*lb/ac*	%
Pil B84	385	100	525	100	737	100
RRIM 5	553	144	654	125	581	108
RRIM 27	–	–	–	–	–	–
RRIM 49	510	132	669	127	632	118
RRIM 99	374	97	571	109	551	103
RRIM 107	669	174	820	156	730	136
RRIM 138	–	–	–	–	–	–
RRIM 142	594	154	640	122	569	106
RRIM 147	–	–	–	–	–	–
RRIM 178	580	151	685	130	574	107
RRIM 195	–	–	–	–	–	–
RRIM 218	–	–	–	–	–	–
Tapping system	S/2.d/2.100%					

TREES IN LARGE SCALE TRIALS ON ESTATES IN LB PER PERCENTAGE OF CONTROL

Estate	*14*							
Age in years	8		9		10		11	
Year of recording	1		2		3		4	
Clones	*lb/ac*	%	*lb/ac*	%	*lb/ac*	%	*lb/ac*	%
Pil B84	714	100	829	100	978	100	1036	100
RRIM 5	–	–	–	–	–	–	–	–
RRIM 27	–	–	–	–	–	–	–	–
RRIM 49	–	–	–	–	–	–	–	–
RRIM 99	–	–	–	–	–	–	–	–
RRIM 107	770	108	861	104	1018	104	1312	127
RRIM 138	–	–	–	–	–	–	–	–
RRIM 142	716	100	802	97	958	98	1356	131
RRIM 147	957	124	964	116	868	89	1040	100
RRIM 178	660	92	721	87	886	91	1029	99
RRIM 195	797	112	860	103	876	90	1118	108
RRIM 218	592	83	706	85	834	85	1078	104
Tapping system	S/2.d/2.100%							

Estate	*73*					
Age in years	9		10		11	
Year of recording	1		2		3	
Clones	*lb/ac*	%	*lb/ac*	%	*lb/ac*	%
Pil B84	–	100	–	100	–	100
RRIM 5	–	–	–	–	–	–
RRIM 27	–	101	–	98	–	102
RRIM 49	–	119	–	99	–	89
RRIM 99	–	92	–	107	–	97
RRIM 107	–	111	–	111	–	96
RRIM 138	–	106	–	102	–	99
RRIM 142	–	103	–	98	–	103
RRIM 147	–	–	–	–	–	–
RRIM 178	–	–	–	–	–	–
RRIM 195	–	–	–	–	–	–
RRIM 218	–	–	–	–	–	–
Tapping system	S/1.d/4.100%					

TABLE XXII: YIELDS OF CLONAL SEED-

Yield of each family is given as a percentage of the control is Pil B84 except for Estate 78 which has PB 86. Tapping

ESTATE	7				9		
Acres per family	3.6				2.5		
Age, years	9	10	11	12	10	11	12
Year of tapping	1	2	3	4	1	2	3
BUDDED CONTROL *lb/ac/yr*	784	988	754	1429	*	692	682
FAMILIES							
Tjir 1 selfed	–	–	–	–	148	130	150
Gl 1 selfed	–	–	–	–	127	118	120
ES F14 A.B.	127	98	113	99	133	117	122
ES F18	116	707	135	103	122	122	135
ES F15 N	–	–	–	–	–	–	–
PBISG C.D.E.	123	107	128	101	132	125	126
ES F4 A	–	–	–	–	126	116	114
Batu Kawan ISG	117	107	124	97	135	122	126
Pil A44 × Pil B84	–	–	–	–	140	111	130
BD 5 selfed	–	–	–	–	121	128	138
Bt Rajah mixed	–	–	–	–	137	133	128
Gadek mixed	–	–	–	–	132	123	129
Tjir 16 selfed	–	–	–	–	125	114	121
Sab 24 selfed	–	–	–	–	137	124	140
Rub 393 selfed	–	–	–	–	117	121	123
Buloh Akar mixed	–	–	–	–	140	126	129
ES F22	–	–	–	–	123	114	129
SReko 9 illeg.	–	–	–	–	113	116	118
RRIM 507 illeg.	–	–	–	–	–	–	–
ES F2	–	–	–	–	126	116	130
ES F16 N	–	–	–	–	123	116	118
PB 25 selfed	–	–	–	–	–	–	–
Cult 88 illeg.	–	–	–	–	–	–	–
PB 86 illeg.	–	–	–	–	141	131	133
BR 2 illeg.	–	–	–	–	–	–	–
DISTRICT	*Central Perak*				*Central Johore*		

* *Yield per acre not recorded.*

† *Control not tapped. Seedling family yields quoted*

LING FAMILIES IN ESTATE TRIALS

control yield (based on cup coagulation recording). The budded S/2.d/2.100%, *except where stated otherwise in the text.*

16 2.0				*28* 3.5				*35* 1.6		
9 1	10 2	11 3	12 4	9 1	10 2	11 3	12 4	10 1	11 2	12 3
*	*	*	*	387	478	598	680	†	389	531
								lb.ac		
208	182	162	137	155	163	123	125	1192	314	261
177	143	137	114	–	–	–	–	993	270	216
179	143	126	101	149	149	115	117	1006	252	203
180	162	142	120	172	159	122	124	933	256	222
181	156	145	131	–	–	–	–	–	–	–
209	162	137	112	189	185	148	144	1218	313	246
169	135	107	86	148	136	114	111	920	233	181
180	147	136	118	183	180	147	142	993	242	217
179	146	122	97	169	152	117	114	1024	244	216
124	103	94	80	127	142	107	114	–	–	–
183	152	145	124	173	169	134	130	–	–	–
192	175	164	130	–	–	–	–	–	–	–
152	129	118	99	–	–	–	–	–	–	–
163	134	123	90	–	–	–	–	–	–	–
171	149	136	122	–	–	–	–	–	–	–
169	138	109	99	–	–	–	–	–	–	–
178	140	120	111	–	–	–	–	–	–	–
164	142	118	94	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
167	142	138	121	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	898	226	183
155	129	128	106	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
Central Pahang				*Selangor Coast*				*North Perak*		

as lb acre for the first year of tapping.

TABLE XXII: (*cont.*) YIELDS OF CLONAL SEED-

ESTATE	*41*				*165*		
Acres per family	2.1				2.5		
Age, years	9	10	11	12	10	11	12
Year of tapping	1	2	3	4	1	2	3
BUDDED CONTROL *lb/ac/yr*	716	892	788	838	320	727	939
FAMILIES							
Tjir 1 selfed	143	110	114	148	230	113	103
Gl 1 selfed	106	95	100	105	–	–	–
ES F14 A.B.	119	94	109	107	–	–	–
ES F18	140	122	121	135	–	–	–
ES F15 N	–	–	–	–	–	–	–
PBISG C.D.E.	129	104	136	146	312	129	106
ES F4 A	103	88	96	98	–	–	–
Batu Kawan ISG	139	114	110	120	271	121	104
Pil A44 × Pil B84	–	–	–	–	243	103	101
BD 5 selfed	135	99	107	115	–	–	–
Bt Rajah mixed	107	92	95	104	–	–	–
Gadek mixed	124	100	113	114	–	–	–
Tjir 16 selfed	107	98	99	96	–	–	–
Sab 24 selfed	109	93	105	119	–	–	–
Rub 393 selfed	112	88	106	121	–	–	–
Buloh Akar mixed	114	96	90	108	–	–	–
ES F22	126	104	100	125	–	–	–
SReko 9 illeg.	108	90	95	103	–	–	–
RRIM 507 illeg.	134	108	111	119	–	–	–
ES F2	106	90	97	109	–	–	–
ES F16 N	96	86	78	92	–	–	–
PB 25 selfed	–	–	–	–	–	–	–
Cult 88 illeg.	–	–	–	–	–	–	–
PB 86 illeg.	113	100	106	114	–	–	–
BR 2 illeg.	–	–	–	–	–	–	–
DISTRICT	*Dindings*				*Central Johore*		

* *Yield per acre not recorded.*

78				*99* 1.5				*100* 3.75			
11	12	13	14	9	10	11	12	9	10	11	12
1	2	3	4	1	2	3	4	1	2	3	4
1174	868	920	1142	*	*	*	*	871	1147	1149	1146
–	–	–	–	115	118	112	96	175	150	150	116
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	118	116	109	96	168	144	144	107
–	–	–	–	117	116	108	88	158	133	145	112
–	–	–	–	112	116	112	102	–	–	–	–
99	95	119	106	123	114	108	99	203	170	181	114
–	–	–	–	–	–	–	–	132	127	126	109
–	–	–	–	131	123	107	96	151	132	142	109
77	80	88	95	120	119	99	104	180	135	136	104
–	–	–	–	–	–	–	–		–	–	–
–	–	–	–	114	115	118	92	130	118	120	104
–	–	–	–	–	–	–	–		–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	118	114	103	93	145	121	119	107
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
			–	–	–	–	–	–	–	–	–
				–	–	–	–	–	–	–	–

Eastern Negri Sembilan	*Central Malacca*	*South Kedah*

I(8) TESTING OF PROMISING PLANTING MATERIAL ON THE R.R.I. EXPERIMENT STATION AND ON ESTATES

Old Standard Clones

*Field 5, R.R.I. Experiment Station** — Over the whole period of recorded tapping, trees of clone Tjir 1 have yielded the most (158 lb dry rubber per tree) followed by PB 186 next (151 lb dry rubber per tree), and clone Pil B84 (143 lb dry rubber per tree). Since recommencement of recording in 1946 clone PB 186 has maintained a slight superiority in yield over clone Tjir 1. Yields are presented in TABLE XIX.

Estate trials – Large scale trials for observing the performance of a selection of the older clones were established before the war on four estates under the terms of the Rubber Regulation scheme† Records of yield for the first three to four years of tapping are presented in TABLE XX. Two points of interest are worth noting; firstly, the better performance of clone Tjir 16 than of clone Tjir 1 on estates 9 and 16, both situated on inland soil, and secondly, the marked improvement in performance of clones Sab 24 and Rub 393, particularly the former clone in the last year of the record.

Clones from Estate Mother Trees in Estate Trials

The clones in these trials are those specially referred to on page 40 of this report. The trials in which they have been budded were established under the provisions of the Rubber Regulation scheme.‡ Their yields in these trials are given in TABLE XXI. The performance of none is consistently outstanding.

Clonal Seedling Families in Estate Trials§

The yields of twentyfive families of seedlings recorded in estate experiments set up under the Rubber Regulation scheme are given in TABLE XXII. The order of merit varies somewhat between estates, but the best families are Tjir 1 selfed seedlings and mixed P.B.I.G. Seedlings, from gardens *C*, *D* and *E*. The next best appear to be derived from R.R.I. Experiment Station Field 18 and Gadek Mixed Seed.

Brown bast incidences have often reached high figures, and in trials on estates 7 and 78 the tapping intensity was reduced for a

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* *Rep. Rubb. Res. Inst. Malaya* (1929) 54, (1936) 54, (1936) 53, (1937) 94, (1938) 67, (1939) 96, (1940) 41, (1945-8) 56

† H.M.S.O. Command Papers 4583. *Rep. Rubb. Res. Inst. Malaya* (1935) 38, (1945-8) 90

‡ *Rep. Rubb. Res. Inst. Malaya* (1935) 38, (1945-8) 90

§ *Rep. Rubb. Res. Inst. Malaya* (1935) 38, (1945-8) 52, 90

period of 18 months in the second and third years of tapping to S/2.d/3.67%. The record of brown bast is given in TABLE XXIII.

New Clones in Trials on R.R.I. Experiment Station and on Estates

*RRIM 500 series clones (first selection): Field 30, R.R.I. Experiment Station** — Yields for 1949, 1950 and 1951 and the mean annual yield for the period 1946-51 are given in TABLE XXIV. Brown bast incidence and wind damage records are given in TABLE XXV. No particular comment is needed on these records. Clones RRIM 501 and 513 show very satisfactory performances. RRIM 512 was included in 1951 with the four other clones tapped on the S/3.d/2.67% system because of a high incidence of brown bast.

RRIM 500 series clones (second selection): Field 38B R.R.I. Experiment Station† — Yields for the first years of tapping are shown in TABLE XXVI. Incidence of brown bast and wind damage is also given in the table. Clone RRIM 527 has given very good yields and clone RRIM 526 comes next in order of yield.

RRIM 500 series clones in estate trials‡ — Yield data from estate trials are set out in TABLE XXVII. RRIM 501 remains the outstanding yielder, but RRIM 513 has also given high yields and in some trials has yielded as much as RRIM 501. RRIM 513 is a slightly more vigorous clone than RRIM 501. Both have white latex, but that of RRIM 513 is stable as a centrifuged concentrate, produces a hard crepe rubber and a hard sheet. Latex of RRIM 501 is known to be unsuitable for centrifuge concentration. Neither clone is above average in susceptibility to brown bast. Clones RRIM 519 and 520 appear promising, but the former is susceptible to brown bast.

New proprietary clones in estate trials — Eight Prang Besar clones are under observation on one estate and five and an estate clone on another estate. Yields are detailed in TABLE XXVIII. Of the Prang Besar clones, 5/37 has been the best yielder but all in these trials have shown a high susceptibility to brown bast. Clone Ward A9 has been doing very well on the alluvial sandy loam of estate a/3. It has a good habit of growth and has not shown any tendency to brown bast.

RRIM 600 series clones (first selection): Field 48A - Nineteen clones (600-618) selected from the clones made from hand pollinated seedlings of the 1937-9 (page 15) breeding programme were

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* *Rep. Rubb. Res. Inst Malaya* (1937) 113, (1938) 96, (1939) 136, (1940) 65, (1945-8) 59

† *Rep. Rubb. Res. Inst. Malaya* (1939) 136, (1940) 65, (1945-8) 59

‡ *Trials established under the Rubber Regulation scheme, Rep. Rubb. Res. Inst. Malaya* (1935) 38, (1945-8) 59, 90

budded in a large scale field trial at the R.R.I. Experiment Station in a balanced incomplete block layout of five replications. RRIM 501 and Tjir 1 are budded as controls.

The clones were cut back in April 1950. The early growth has been excellent but with some significant variation in vigour. After one year clones RRIM 600, 613 and 616 were significantly more vigorous than all the other clones of the trial. Clones 607, 608, 609 and 617 were the least vigorous. Yields of these clones recorded in small scale trials are given in TABLES XV to XVII.

RRIM 600 series clones (second selection): Field 48D — Twelve clones (619-630) selected from the clones of the 1937-40 hand pollinated seedlings (page 15) were budded in a balanced incomplete block layout of four replications with RRIM 501 as the control. The trial was cut back in early 1951 and growth has been excellent. Yields from these clones in small scale trials are given in TABLES XV to XVIII.

RRIM 600 series clones (second selection) in hedge row planting — The same clones that have been budded in the trial described above have also been budded at a planting distance of 60 feet × 4½ feet. As the spacing of the former trial is 20 feet × 10 feet and the two trials adjoin, a useful comparison of the performance of these clones on the two systems of planting is hoped for.

Trials of RRIM 600 series clones on estates — Twenty one estates are cooperating in a balanced incomplete block trial of 13 clones with four replications. The clones selected are RRIM 604, 605, 608, 609, 610, 611, 612, 614, 615, 616, 617 and 618 with RRIM 501 as control. Each collaborating estate is planting one or more blocks of 4 half-acre plots of one clone per plot. Blocks not containing RRIM 501 in the distribution have an extra plot of this clone as a local control. Nine of these estates are employing an avenue system of planting with rows 30 feet apart. The other 12 estates are planting at more equal planting distances. Mean budding results from twelve estates are:

Clone	*Buds obtained per yard*	*Final budding success*	*Final success of buds per yard*
501	11.2	91.4%	10.2
604	15.0	82.8	12.4
605	16.1	92.2	14.8
606	12.2	76.8	9.4
608	15.0	72.8	10.9
609	13.5	93.9	12.7
610	19.4	90.6	10.4
611	12.2	88.8	10.8

Clone	*Buds obtained per yard*	*Final budding success*	*Final success of buds per yard*
612	12.2	78.7	9.6
614	13.5	77.3	10.4
615	10.4	73.9	7.7
616	8.9	85.5	7.6
617	16.3	89.8	14.6
618	12.8	94.9	12.1

Several self contained large scale trials have been arranged on Estates. One trial containing RRIM 600 to 618, LCB 1320 and RRIM 501 was budded on a hedge row planting system. Another trial was established on an avenue system of 30 feet × 7 feet spacing and rectangular planting was used in two other trials.

II

PROPAGATION AND PLANTING TECHNIQUE

PREPARATION OF HEVEA PLANTING MATERIAL

Vegetative Propagation

Budgrafting onto a mature root system Budgrafting onto the main lateral roots of old rubber trees was first carried out in 1920 at the Cultuurtuin, Buitenzorg (Bogor), Java.* If such grafts could be successfully grown under the shade of old rubber trees as 'semi-parasites', retaining their connection with the host and drawing on food produced by it, it might be possible to grow them to near maturity, before cutting out the host. Such a practice might have a possible application in replanting. Although such a budgrafting operation is easy to carry out, it has been found that the buds will not shoot until the roots they are grafted onto have been severed from the host tree.

In 1943, during the Japanese Occupation of Malaya, a number of buddings was made on the main lateral roots of fifteen year old seedling trees in Field 4D of the R.R.I. Experiment Station. Budding was fairly successful but the detailed results have been lost. The buds were forced to shoot and grow by severing the roots from the trees. Three months after budding, when the area was cleared by the Japanese for food cultivation, the young buddings had grown much more vigorously than stem buddings of the same age made in new clearings, and had two whorls of abnormally large sized leaves.

* VAN HELTEN, W.M. *Arch. Rubbercult. Ned.-Ind.* 5 (1921) 8

TABLE XXIII: BROWN BAST INCIDENCE OF CLONAL SEEDLINGS IN ESTATE TRIALS *(as percentage of mature trees)*

Estate	*7*		*9*	*16*	*28*		*35*		*41*		*58*		*78*	*99*	*100*		*165*
Year of tapping	3	4	2	4	3	4	2	3	3	4	3	4	4	3	3	4	3
Budded control Pil B84	8	4	2	14	1	5		13	2	2	3	2	4	3	8	14	0
Tjir 1 selfed	–	–	6	16	2	6	17	19	4	5	3	17	–	4	14	27	2
Gl 1 selfed	–	–	5	9	–	–	16	23	3	12	7	15	–	–	–	–	–
ES F14 A.B.	7	23	8	12	2	4	21	25	2	6	8	23	–	3	21	34	–
ES F18	3	6	13	15	2	8	20	20	7	5	4	15	–	7	9	21	–
ES F15 N	–	–	-	15	–	–	–	–	–	–	4	10	–	7	–	–	–
PBISG C.D.E.	5	15	1	23	1	5	23	16	3	11	9	26	10	12	14	34	-
ES F4 A	–	–	6	12	3	9	23	21	4	6	5	20	–	–	14	33	–
Batu Kawan ISG	4	17	4	6	1	5	21	18	2	6	6	18	–	12	8	22	5
Pil A44 × Pil B84	–	–	7	19	1	11	20	19	–	–	11	26	17	8	26	39	1
BD 5 selfed	–	–	6	8	1	7	–	–	3	6	–	–	–	–	–	–	–
Bt Rajah mixed	–	–	2	4	2	5	–	–	4	12	–	–	–	0	6	21	–
Gadek mixed	–	–	3	8	–	–	–	–	3	6	–	–	–	–	–	–	–
Tjir 16 selfed	–	–	2	7	–	–	–	–	3	11	–	–	–	–	–	–	–
Sab 24 selfed	–	–	2	18	–	–	–	–	1	8	–	–	–	–	–	–	–
Rub 393 selfed	–	–	5	17	–	–	–	–	5	7	–	–	–	–	–	–	–
Buloh Akar mixed	–	–	3	21	–	–	–	–	2	3	–	–	–	–	–	–	–
ES F22	–	–	2	15	–	–	–	–	5	3	–	–	–	–	–	–	–
SReko 9 illeg	–	–	2	19	–	–	–	–	3	4	–	–	–	–	–	–	–
RRIM 507 illeg	–	–	–	–	–	–	–	–	3	7	–	–	–	–	–	–	–
ES F2	–	–	4	2	–	–	–	–	1	2	–	–	–	–	–	–	–
ES F16 N	–	–	2	0	–	–	20	23	2	10	–	–	–	8	9	15	–
PB 25 selfed	–	–	–	11	–	–	–	–	–	–	–	–	–	–	–	–	–
PB 86 illeg	–	–	2	–	–	–	–	–	5	9	–	–	–	–	–	–	–

Budded control for all estates is Pil B84, except Estate 78 which has PB 86 as control.
All records taken on S/2.d/2.100% tapping, except Estate 7, which was on S/2.d/3.67% in the 3rd year of tapping and Estate 78 which was tapped S/2.d/3.67% for 18 months during the 2nd and 3rd years of tapping.

TABLE XXIV. YIELDS OF R.R.I. 500 SERIES CLONES (1st selection)

Field	Clones	1949		1950		1951		1946-51 annual mean	
		lb/acre	%	lb/acre	%	lb/acre	%	lb/acre	%
30A	RRIM 500*	1560	123	1595	97	1412	100	1469	114
	RRIM 501	2418	191	2388	146	1965	140	2112	165
	RRIM 502	1341	106	1671	102	1230	87	1417	110
	RRIM 503	1353	107	1591	97	1115	79	1375	107
	RRIM 504	1656	131	1690	103	1440	102	1657	129
	RRIM 505	863	68	1069	65	826	59	926	72
	RRIM 506*	1197	94	1198	73	1110	79	1210	94
	RRIM 507	1410	111	1619	99	1445	103	1391	108
	RRIM 508	1668	132	1882	115	1349	96	1605	125
	RRIM 509	1526	120	1647	100	1229	87	1671	130
	RRIM 510	1142	90	1279	78	898	64	1260	98
	RRIM 511	2149	170	2150	131	1610	114	1934	151
	RRIM 512†	1713	135	1271	78	760	54	1388	108
	Pil B84	1267	100	1639	100	1408	100	1284	100
30B	RRIM 513	2067	188	2181	170	1956	175	1960	189
	RRIM 514	1182	108	1657	129	1548	138	1308	126
	RRIM 515	1353	123	1475	115	1121	100	1284	124
	RRIM 516*	1314	120	1509	118	1494	134	1481	143
	RRIM 517	981	89	1115	87	928	83	966	93
	RRIM 518	979	89	1287	100	1310	117	1086	105
	RRIM 519*	1562	142	1766	138	1493	133	1426	137
	RRIM 520	1604	146	1651	129	1528	137	1472	142
	RRIM 521	1201	109	1486	116	1049	94	1323	127
	RRIM 522	1684	154	1524	119	1255	112	1338	129
	Pil B84	1097	100	1284	100	1119	100	1038	100

*Budded October 1937. Tapped from January 1946 on S/2.d/2.100% except * tapped on S/3.d/2.67% from May 1948 and † tapped on S/3.d/2.67% from April 1951 because of a high incidence of brown bast.*

TABLE XXV: RECORD OF BROWN BAST AND WIND DAMAGE IN R.R.I. 500 SERIES CLONES (*First selection*)

Field	*Clones*	*Brown bast incidence*								*Wind damage*							
		1949		*1950*		*1951*		*1946-51*		*1949*		*1950*		*1951*		*1946-51*	
		No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
30A	*RRIM 500**	2	1.2	7	3.8	1	0.6	35	20.3	–	–	–	–	–	–	3	1.6
	RRIM 501	3	1.8	4	2.3	5	2.9	26	15.1	3	1.6	2	1.1	1	0.5	16	8.5
	RRIM 502	2	1.1	8	4.5	4	2.3	28	15.7	5	2.6	–	–	1	0.5	11	5.6
	RRIM 503	4	2.4	7	4.2	3	1.9	26	15.6	2	1.1	4	2.2	4	2.1	11	6.0
	RRIM 504	2	1.2	5	2.3	2	1.1	19	10.8	1	0.6	1	0.5	–	–	6	3.3
	RRIM 505	2	1.3	2	1.4	–	–	10	6.6	9	5.1	14	8.0	17	9.7	57	32.4
	*RRIM 506**	4	2.7	4	2.5	4	2.6	44	27.6	6	3.2	–	–	2	1.1	12	6.4
	RRIM 507	1	0.6	4	2.1	5	2.7	14	7.6			2	1.0	–	–	4	2.0
	RRIM 508	6	3.3	3	1.7	4	2.3	18	10.0	–	–	–	–	2	1.0	5	2.6
	RRIM 509	2	1.2	13	7.8	5	3.1	29	17.4	3	1.6	2	1.1	3	1.6	15	8.2
	RRIM 510	3	1.8	5	3.0	7	4.2	21	12.4	1	0.5	1	0.5		–	5	2.6
	RRIM 511	4	2.5	10	5.9	9	5.5	39	23.3	1	0.5	1	0.5	6	3.3	11	7.0
	RRIM 512†	6	3.6	18	10.4	3	1.9	46	27.0	2	1.1	1	0.5	–	–	4	2.1
	Pil B84	1	0.6	5	3.0	2	1.2	18	10.7	2	1.1	1	0.5			6	3.2
30B	*RRIM 513*	2	1.2	5	2.9	4	2.4	25	15.1	1	0.5	–	–	–	–	3	1.5
	RRIM 514	2	1.1	1	0.5	1	0.6	7	3.8	1	0.5	–	–	–	–	1	0.5
	RRIM 515	7	4.0	6	3.4	6	3.5	39	21.7	2	1.0	1	0.5	1	0.5	8	4.1
	*RRIM 516**	3	1.8	2	1.1	2	1.1	30	17.8	1	0.5	–	–	–	–	5	2.6
	RRIM 517	2	1.3	1	0.6	1	0.6	7	4.5	1	0.6	2	1.2	–	–	3	1.8
	RRIM 518	–	–	1	0.5	1	0.6	3	1.6	–	–	–	–	–	–	1	0.5
	*RRIM 519**	3	1.8	4	2.2	8	4.5	46	27.5	–	–	–	–	–	–	3	1.6
	RRIM 520	3	1.7	1	0.6	4	2.5	26	15.6	1	0.6	5	2.8	1	0.6	9	5.2
	RRIM 521	2	1.2	6	3.3	6	3.4	32	19.1	3	1.6	–	–	–	–	4	2.1
	RRIM 522	1	0.6	3	1.7	5	2.9	27	16.0	–	–	1	0.5	–	–	2	1.0
	Pil B84	2	1.2	4	2.2	–	–	15	8.5	–	–	1	0.5	2	1.1	4	2.1

All clones tapped S/2.d/2.100% *from January* 1946 *except for clones marked* * – *tapped* S/3.d/2.67% *from May* 1948 *and* † – *tapped* S/3.d/2.67% *from April* 1951 *because of a high incidence of brown bast.*

This experiment has been repeated in Field 47 on the trees of the boundary rows to the Replanting Experiment. The budding operation (using the coconut leaf and string method) was unsuccessful owing to penetration of water as a result of a heavy downpour of rain one day during the critical period between budding and opening.

Pre-budding treatment of budwood — An experiment to test the effect of ringing young nursery buddings of clones RRIM 501 and Tjir 1 at various intervals before cutting the budwood, and of storing for various periods before budding, was carried out on the RRIM Experiment Station. The following treatments were used:

Ringbarking: 0, 5, 10, 15, 20 and 25 days before cutting.
Storing: 0, 3, 6, 9, 12 and 15 days before budding.

The final budding results have been analysed by the Statistician who reports as follows: delay between cutting and budding has no detectable effect with clone RRIM 501 but with clone Tjir 1 delays of 0, 3 or 6 days give a smaller final percentage success than delays of 9, 12 or 15 days. Delay between ringbarking and cutting has no detectable effect with clone Tjir 1 but with clone RRIM 501 absence of delay gives a smaller final percentage budding success than that obtained with delays of 5 or more days.

Wastage of buds as a result of treatment, *i.e.* buds which become unusable for budding, could be a very important factor for or against treatment of valuable or expensive budwood. Further examination has therefore been undertaken to evaluate the sum effect of the treatment on viability of usable buds and wastage of buds and budwood.

For the two clones used the total evidence from one did not support that from the other. However certain conclusions may be drawn. Though the effect of ringing on budding success was not identical in both clones, the number of successful buddings per yard was significantly improved for both by ringing for periods of 15-20 days. This was due to the greater facility with which it was possible to strip buds cut from budwood subjected to such ringing treatment than from budwood ringed for shorter periods. From this evidence there would seem to be good grounds for adopting as a general estate practice a policy of ringing all budwood for approximately two to three weeks before cutting it for use.

The procedure in ringing is simply to select good, clean stripping stems of budwood and to remove an inch wide ring of bark near the base. (page 64)

TABLE XXVI: YIELD BROWN BAST INCIDENCES AND
(*Second*

Clones	*Tapping year 1*		*Tapping year 2*	
			Yield in lb/acre	
	lb	%	*lb*	%
RRIM 523	573	129	770	122
RRIM 524	562	126	682	108
RRIM 525	601	135	734	117
RRIM 526	773	174	996	158
RRIM 527	774	174	1122	178
RRIM 528	247	55	377	60
RRIM 529	612	137	711	113
Pil B84	445	100	629	100

Clones			*Incidence of*	
	No.	%	*No.*	%
RRIM 523	3	1.7	2	0.8
RRIM 524	1	0.5	–	–
RRIM 525	5	3.0	3	1.3
RRIM 526	1	0.4	4	1.5
RRIM 527	2	0.9	2	0.7
RRIM 528	2	0.8	4	1.4
RRIM 529	3	1.6	6	2.5
Pil B84	–	–	3	1.1

Clones			*Incidence of*	
	No.	%	*No.*	%
RRIM 523	6	2.2	5	1.8
RRIM 524	2	0.7	2	0.7
RRIM 525	1	0.4	–	–
RRIM 526	2	0.7	3	1.1
RRIM 527	1	0.4	1	0.4
RRIM 528	3	1.1	–	–
RRIM 529	2	0.7	3	1.1
Pil B84	1	0.4	1	0.4

Percentage of brown bast represents the incidence amongst
The 'tapping year' is from August to July. The mean thus
Tapping system S/2.d/2.100%. *Tapping commenced in*
in July 1951.

WIND DAMAGE OF RRIM 500 SERIES CLONES

selection)

Tapping year 3		*Tapping year 4*		*Mean of 4 tapping years*	
and as percentage of control					
lb	%	*lb*	%	*lb*	%
1120	106	1077	93	885	108
1062	101	1122	97	857	104
1143	109	1224	106	926	113
1534	146	1432	123	1184	144
1762	167	1823	157	1370	167
647	62	790	68	515	63
1181	112	1042	90	886	108
1053	100	1161	100	821	100

brown bast				*Total*	
No.	%	*No.*	%	*No.*	%
10	4.1	25	10.0	40	16.6
2	0.8	12	4.8	15	6.1
4	1.7	18	7.5	29	12.9
8	2.9	15	5.5	28	10.3
3	1.1	17	5.9	25	9.1
5	1.8	7	5.2	18	6.5
8	3.8	8	3.2	25	10.5
3	1.1	5	1.9	11	4.1

wind damage				*Total*	
No.	%	*No.*	%	*No.*	%
2	0.7	1	0.4	14	5.1
–	–	3	1.0	7	2.4
–	–	3	1.1	4	1.5
–	–	5	1.8	10	3.6
1	0.4	2	0.7	5	1.7
–	–	–	–	3	1.1
2	0.7	7	2.4	14	4.8
2	0.7	4	1.4	8	2.9

the mature stand at the end of the period of each record.

refers to the period August 1947 *to July* 1951.

August 1947. *Second panel opened at* 40 *inches from the union*

TABLE XXVII: YIELDS OF RRIM 500

Yield of control given in lb/

Yield of clones given as percentage of the yield

Tapping system for all trials S/2.d/2.100% *except Estate a/1 on* S/1.d/4.100%

Estate	*a/1*		*a/2*				*a/3*		
Age in years	10	11	9	10	11	12	11	12	13
Year of tapping	1	2	†2	3	4	5	‡3	4	5
Control Pil B84 lb/ac/year	*	*	585	638	613	996	*	*	*
RRIM 500	–	–	123	106	169	123	117	127	90
RRIM 501	146	174	165	123	171	149	188	169	130
RRIM 502	–	–	–	–	–	–	–	–	–
RRIM 503	–	–	–	–	–	–	–	–	–
RRIM 504	–	–	–	–	–	–	–	–	–
RRIM 505	–	–	121	104	122	120	–	–	–
RRIM 506	–	–	131	98	123	88	129	116	92
RRIM 507	–	–	155	115	160	133	–	–	–
RRIM 508	–	–	–	–	–	–	–	–	–
RRIM 509	125	100	–	–	–	–	–	–	–
RRIM 510	192	210	–	–	–	–	–	–	–
RRIM 511	–	–	135	117	125	106	–	–	–
RRIM 512	–	–	–	–	–	–	–	–	–
RRIM 513	150	172	–	–	–	–	–	–	–
RRIM 514	–	–	107	101	106	106	–	–	–
RRIM 515	–	–	141	109	137	122	–	–	–
RRIM 516	–	–	–	–	–	–	–	–	–
RRIM 517	–	–	–	–	–	–	–	–	–
RRIM 518	–	–	107	93	88	85	–	–	–
RRIM 519	121	112	–	–	–	–	–	–	–
RRIM 520	–	–	–	–	–	–	–	–	–
RRIM 521	–	–	–	–	–	–	–	–	–
RRIM 522	–	–	111	95	123	101	–	–	–
RRIM 523	–	–	–	–	–	–	–	–	–
RRIM 525	–	–	–	–	–	–	–	–	–
RRIM 526	–	–	–	–	–	–	–	–	–
RRIM 527	–	–	–	–	–	–	–	–	–
RRIM 528	–	–	–	–	–	–	–	–	–
RRIM 529	–	–	–	–	–	–	–	–	–
Lun N	–	–	118	107	143	153	–	–	–
District	*Central Perak*		*N. Perak, coastal*				*Central Selangor*		

* *Yield per acre not recorded*

† *First year of tapping not recorded*

‡ *First 2 years of tapping not recorded*

SERIES CLONES IN ESTATE EXPERIMENTS

acre/year (where so recorded)

of the control (based on cup coagulation recording)

V/2.d/2.100%, *and Estates 43 (first year of tapping) and 73, on*

a/4				*a/7*		*9*			*14*			
8	9	10	11	9	10	9	10	11	8	9	10	11
1	2	3	4	1	2	1	2	3	†2	3	4	5
835	928	807	1140	*	*	*	785	741	714	829	978	1036
125	122	110	107	147	132	166	144	136	–	–	–	–
132	151	157	136	–	–	185	171	160				
–	–	–	–	131	117	205	150	134	–	–	–	–
–	–	–	–	–	–	192	148	143				
–	–	–	–	–	–	178	164	130	–	–	–	–
–	–			111	93	130	113	93	117	104	101	117
–	–	–	–	178	127	192	148	116	–	–	–	–
110	95	99	112	–	–	133	115	133	–	–	–	–
–	–	–	–	–	–	123	121	114	–	–	–	–
–	–	–	–	117	98	182	150	121	172	141	109	125
–	–	–	–	–	–	182	130	109	–	–	–	–
–	–	–	–	123	118	–	–	–		–	–	–
–	–	–	–	147	131	178	134	121	–	–	–	–
–	–	–	–	–	–	208	180	163				
–	–	–	–	108	99	172	143	134		–		
–	–	–	–	68	70	144	123	108	–	–	–	–
–	–	–	–	–	–	172	157	136	–	–	–	–
–	–	–	–	–	–	–	–	–				
111	109	109	92	–	–	136	129	124				
–	–	–	–	–	–	157	144	148		–	–	–
–	–	–	–	–	–	166	148	153	–	–	–	–
–		–	–	–	–	166	128	127	–	–	–	–
–		–	–	–	–		–		–	–		–
132	130	104	106	–	–		–	–		–	–	–
–				–	–			–		–	–	–
–				–	–			–		–	–	–
–	–	–	–	–	–	–	–	–	169	145	121	138
–	–	–	–	–				–			–	–
–	–	–	–	–	–			–			–	–
–			–	–							–	–

West Negri Sembilan | *Central Selangor* | *Central Johore* | *Central Selangor*

TABLE XXVII: (*cont.*) YIELDS OF RRIM 500

Yield of control given in lb/

Yield of clones given as percentage of the yield

Tapping system for all trials S/2.d/2.100% *except Estate a/1 on* S/1.d/4.100%

Estate	*16*				*28*			
Age in years	9	10	11	12	9	10	11	12
Year of tapping	1	2	3	4	1	2	3	4
Control Pil B84 lb/ac/year	*	*	*	*	496	567	666	743
RRIM 500	166	147	110	124	188	147	172	143
RRIM 501	168	167	140	156	192	202	204	165
RRIM 502	194	181	135	124	–	–	–	–
RRIM 503	171	167	128	124	–	–	–	–
RRIM 504	188	158	127	103	173	152	161	131
RRIM 505	125	91	77	70		–	–	–
RRIM 506	175	138	99	99	187	179	170	142
RRIM 507	155	132	103	113	–	–	–	–
RRIM 508	153	151	119	116			–	–
RRIM 509	196	163	133	115	–	–	–	–
RRIM 510	126	124	115	88	151	148	143	127
RRIM 511	–	–	–	–	–	–	–	–
RRIM 512	142	155	93	106	–	–	–	–
RRIM 513	178	190	130	121	168	173	188	158
RRIM 514	161	178	137	118	128	115	132	137
RRIM 515	134	111	98	107	–	–	–	–
RRIM 516	184	167	151	133	–	–	–	–
RRIM 517	–	–	–	–	–	–	–	–
RRIM 518	121	112	107	97	128	115	125	129
RRIM 519	169	146	123	144	165	158	149	132
RRIM 520	166	152	122	124	–	–	–	–
RRIM 521	143	135	107	117	–	–	–	–
RRIM 522	–	–	–	–	–	–	–	–
RRIM 523	–	–	–	–	–	–	–	–
RRIM 525	–	–	–	–	–	–	–	–
RRIM 526	–	–	–	–	–	–	–	–
RRIM 527	–	–	–	–	–	–	–	–
RRIM 528	–	–	–	–	–	–	–	–
RRIM 529	–	–	–	–	–	–	–	–
Lun N	–	–	–	–	–	–	–	–
District	*West Pahang*				*Selangor coastal*			

* *Yield per acre not recorded*

SERIES CLONES IN ESTATE EXPERIMENTS

acre/year (where so recorded)

of the control (based on cup coagulation recording)

V, 2.d/2.100%, *and Estates 43 (first year of tapping) and 73, on*

35			*39*				*41*				*43*	
9	10	11	9	10	11	12	9	10	11	12	9	10
1	2	3	1	2	3	4	1	2	3	4	1	2
480	678	773	*	*	*	*	626	641	592	776	1174	728
184	148	129	–	–	–		161	154	131	136	136	142
174	193	173	162	144	184		170	192	170	159	132	188
324	179	136	–	–	–		180	165	116	111	–	–
362	256	177	–	–	–		207	166	112	100		
–	–		–	–			158	158	131	110	134	136
–	–		–	–			113	124	109	99	–	–
–	–	–	140	136	128		165	146	132	107	127	122
221	117	124	–	–	–		136	121	110	106	–	–
–	–			–	–		144	163	146	140		–
–	–	–		–	–		188	177	139	116	–	–
–	–			–	–		176	162	126	96	–	–
–	–	–		–			191	164	131	116		–
–	–	–			–		157	157	113	89	–	–
308	252	170	–	–	–		150	168	148	135	128	152
	–	–	132	133	152		126	143	131	123	91	125
–	–	–	–	–	–		147	142	120	99	–	–
–	–	–	–	–	–		–	–	–	–	–	–
–	–	–	–	–	–		–	–	–	–	–	–
213	159	136	105	111	140		115	118	99	94		–
280	199	162	–	–	–		165	167	132	118	–	–
350	212	165	–	–	–		137	139	115	107	–	–
–	–	–	–	–	–		–	–	–	–	–	–
–	–	–	–	–	–		144	126	112	93	–	–
	–	–	–	–	–		–	–	–	–	–	–
–	–	–	–	–	–		–	–	–	–	–	–
–	–	–	–	–	–		–	–	–	–	–	–
–	–	–	–	–	–		–	–	–	–	–	–
–	–	–	–	–	–		–	–	–	–	–	–
–	–	–	–	–	–		–	–	–	–	–	–
–	–	–	–	–	–		–	–	–	–	94	116
North Perak			*East Negri Sembilan*				*Dindings, coastal*				*Selangor coastal*	

TABLE XXVII: (*cont.*) YIELDS OF RRIM 500

Yield of control given in lb/

Yield of clones given as percentage of the yield

Tapping system for all trials S/2.d/2.100% *except Estate a/1 on* S/1.d/4.100%

Estate	*44*				*73*		
Age in years	8	9	10	11	9	10	11
Year of tapping	1	2	3	4	1	2	3
Control Pil B84 lb/ac/year	*	*	*	*	*	*	*
RRIM 500	160	149	165	129	–	–	–
RRIM 501	166	173	179	167	–	–	–
RRIM 502	–	–	–	–	138	122	99
RRIM 503	–	–	–	–	–	–	–
RRIM 504	–	–	–	–	–	–	–
RRIM 505	118	109	118	111	126	103	93
RRIM 506	150	151	150	124	–	–	–
RRIM 507	–	–	–	–	–	–	–
RRIM 508	–	–	–	–	–	–	–
RRIM 509	–	–	–	–	–	–	–
RRIM 510	–	–	–	–	–	–	–
RRIM 511	–	–	–	–	–	–	–
RRIM 512	–	–	–	–	–	–	–
RRIM 513	–	–	–	–	–	–	–
RRIM 514	–	–	–	–	–	–	–
RRIM 515	–	–	–	–	–	–	–
RRIM 516	–	–	–	–	–	–	–
RRIM 517	–	–	–	–	–	–	–
RRIM 518	–	–	–	–	–	–	–
RRIM 519	–	–	–	–	–	–	–
RRIM 520	–	–	–	–	–	–	–
RRIM 521	–	–	–	–	–	–	–
RRIM 522	–	–	–	–	–	–	–
RRIM 523	–	–	–	–	–	–	–
RRIM 525	–	–	–	–	–	–	–
RRIM 526	–	–	–	–	–	–	–
RRIM 527	–	–	–	–	–	–	–
RRIM 528	–	–	–	–	–	–	–
RRIM 529	–	–	–	–	120	101	–
Lun N	–	–	–	–	–	–	–
District	*Central Pahang*				*Selangor inland*		

* *Yield per acre not recorded*

SERIES CLONES IN ESTATE EXPERIMENTS

acre/year (where so recorded)

of the control (based on cup coagulation recording)

V/2.d/2.100%, *and Estates 43 (first year of tapping) and 73, on*

122			*165*			*175*			
9	10	11	9	10	11	8	9	10	11
1	2	3	1	2	3	1	2	3	4
385	525	537	744	989	1056	395	675	816	992
–	–	–	121	97	96	169	137	159	123
–	–	–	150	112	103	169	150	177	147
262	185	128	–	–	–	162	127	150	120
–	–	–	–	–	–	–	–		
–	–	–	64	95	86	–	–		–
–	–	–	–			134	94	102	108
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	199	166	160	134
–	–	–	–	–	–	–	–	–	–
–	–	–	171	124	109	–	–	–	–
–	–	–	135	112	98	–			–
–	–	–	–	–	–			–	–
–	–	–	89	100	94	160	131	153	136
172	142	122	–	–	–	112	125	125	105
–	–	–	161	115	103	–	–		–
–	–	–	40	69	88	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	124	98	93	–		–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–		–	–	–	–
–	–	–	–	–	–	–		–	–
188	158	124	–	–	–	–	–	–	–
–	–	–	–	–		173	129	119	102
–	–	–	–	–	–	–		–	–
–	–	–	–	–	–		–	–	–
–	–	–		–	–	71	76	84	79
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
North Perak			*Central Johore*			*Kelantan*			

TABLE XXVIII: YIELDS OF NEW PROPRIETARY CLONES IN ESTATE TRIALS

Estate	*28*								*a/3*		
Year from budding	9		10		11		12		11	12	13
Yield	*lb/tree*	%	*lb/tree*	%	*lb/tree*	%	*lb/tree*	%	%	%	%
Pil B84	5.0	100	6.3	100	9.0	100	7.7	100	100	100	100
PB 5/37	12.3	246	13.2	210	15.8	176	11.2	145	214	198	138
PB 5/51	11.5	230	11.4	181	10.5	117	7.8	101	161	160	121
PB 5/60	9.9	198	8.7	138	10.2	113	11.0	143	200	178	158
PB 5/76	9.4	188	7.3	116	11.0	122	8.9	116	–	–	–
PB 5/122	11.2	224	10.5	167	10.2	113	12.7	165	–	–	–
PB 5/139	7.8	156	7.9	125	13.4	149	13.6	173	144	142	118
PB 6/9	9.9	198	9.8	156	19.4	216	17.3	225	139	128	89
PB 6/24	7.4	148	7.4	117	8.7	97	14.7	191	117	117	109
PB 6/50	8.6	172	8.7	138	12.4	138	11.2	145	–	–	–
Ward A9	–	–	–	–	–	–	–	–	201	220	189
Tapping system	S/2.d/2.100%								S/2.d/2.100%		
Soil type	*Coastal clay with peat*								*Alluvial sandy loam*		

TABLE XXIX: STORAGE TRIAL WITH HEVEA SEED

Treatment	*Container*	*Moisture %*	*Fungicide*	*Atmosphere*	*Mean % germination*		*Av. time of germin. (days)*
					During storage	*During and after storage*	
1	*Sealed tin*	15	*'Agrosan'*	*Nitrogen*	0	99	11.4
2	*Sealed tin*	15	*'Agrosan'*	*Air*	0	97	11.3
3	*Sealed tin*	15	*Nil*	*Nitrogen*	0.7	98	10.5
4	*Sealed tin*	15	*Nil*	*Air*	0	98	10.7
5	*Wooden box*	15	*'Agrosan'*	*Air*	1.3	83	14.2
6	*Wooden box*	15	*Nil*	*Air*	0	85	15.1
7	*Sealed tin*	20	*'Agrosan'*	*Nitrogen*	1.3	100	10.8
8	*Sealed tin*	20	*'Agrosan'*	*Air*	0	100	9.9
9	*Sealed tin*	20	*Nil*	*Nitrogen*	0	100	10.5
10	*Sealed tin*	20	*Nil*	*Air*	1.3	100	10.0
11	*Wooden box*	20	*'Agrosan'*	*Air*	5.3	95	10.0
12	*Wooden box*	20	*Nil*	*Air*	4.7	97	10.8
13	*Sealed tin*	25	*'Agrosan'*	*Nitrogen*	2.0	99	10.0
14	*Sealed tin*	25	*'Agrosan'*	*Air*	3.3	100	10.7
15	*Sealed tin*	25	*Nil*	*Nitrogen*	2.0	99	10.0
16	*Sealed tin*	25	*Nil*	*Air*	0	100	9.7
17	*Wooden box*	25	*'Agrosan'*	*Air*	26.7	100	10.2
18	*Wooden box*	25	*Nil*	*Air*	20.0	99	10.2
19	*Control.*	*Seeds put down for germination immediately after collection*				90	37.6

Storage resulted in a marked effect on budwood of RRIM 501. For three days and over there was a rapid increase in the proportion of buds not stripping which more than offset any possible improvement there might have been in the budding success with buds from the stored budwood.

Storage of Tjir 1 budwood over eight days gave an improved budding success, even after correction for the proportion of buds not stripping on account of the storage treatment. Nine days storage was an optimum period for successful budding.

A new binding material — Tests with a polyvinyl tape as binding material for budgrafting were carried out. This material was compared with the widely used coconut frond and string on vigorously growing nursery seedlings. Each type of material gave 100% successes. The polyvinyl tape, 1 inch to $1\frac{1}{4}$ inches width, would seem to be entirely satisfactory for this purpose but no comparison of costs could be made as the price of the tape is not known.

Storage of Hevea Seeds

An experiment was carried out in collaboration with the Pathological Division, to investigate the effect on the storage of rubber seed of various methods of packing in powdered charcoal. The seeds were obtained from a monoclonal area of Tjir 1.

There were 19 treatment each with 3 replications and 50 seeds in each replication. The seeds in the first eighteen treatments remained packed for 21 days when they were removed and placed in sawdust for germination. The control seeds were planted immediately after collection. The results in TABLE XXIX show:

(*a*) little evidence of differences in mean germination time between treatments 1 to 4 and 7 to 18 but treatments 5 and 6 both of which involved a wooden container and charcoal of 15% moisture content showed a significantly greater mean germination time.

(*b*) a significantly lower percentage germination in treatments 5, 6 and 19 (control) and little difference among the remaining treatment.

(*c*) a marked treatment effect on percentage germination during storage, the effect being pronounced in treatments 17, 18, 11 and 12 which were treatments involving a wooden container and powdered charcoal with moisture content of either 20 or 25%.

(*d*) no evidence of any effect associated with 'Agrosan' or nitrogen.

The mean percentage of deaths was 16 in treatments five and six, 10 in the control, and negligible in all other treatments. An

interesting and unexpected result which merits further investigation is that the mean germination time in all storage treatments including the time of storage, is less than in the control.

The experiment has shown that for a long period of storage, for example when seeds have to travel a great distance, the best results would be obtained by packing them in a sealed tin using as packing material powdered charcoal with a moisture content of about 20% by weight.

Method of Planting

Two trials were established before the war, one on an inland and the other on a coastal estate, to compare various methods of planting. These trials have now been tapped for four years and the records of yield are given in TABLE XXX.

The initial advantage of age of the nursery grown material was shown in the early yields. By the fourth year of tapping the annual yield from the different classes of planting material had become uniform on the inland estate. On the coastal estate the advantage of age was still apparent. The older material was still maintaining a lead in girth, but the differences between the various groups were annually becoming smaller.

II(2) STOCK SCION RELATIONSHIP

Work under this heading has continued during the period under review and will be reported in a separate communication of the Journal of the R.R.I. of Malaya.

II(3) DENSITY OF PLANTING AND DISTRIBUTION

*Experiment in Fields 14C & D, R.R.I. Experiment Station**

The yield data from this experiment additional to the records previously published are given in TABLE XXXI.

The differences between girths of the trees of the different densities are still being increased, the less densely planted trees having a greater increment than the more densely planted. The most densely planted plots (435 per acre) remain the highest yielding, but the trees are small with thin bark and since the high yield is obtained from a large number of low yielding trees the tapping cost is high. The stand per acre commensurate with adequate girth and bark thickness, factors directly related to the planting density and the economics of tapping, would appear to be within the wide range of 125 to 222 trees per acre.

* *Rep. Rubb. Res. Inst. Malaya* (1930) 61, (1931) 56, (1932) 62, (1933) 72, (1934) 70, (1935) 73, (1936) 56, (1937) 96, (1938) 70, (1939) 98, (1940) 46, (1945-8) 69

Hedge Row Density of Planting Trial: Field 52, R.R.I. Experiment Station

This experiment was set up in October and November 1951. Three hedge row spacings (50, 65 and 80 feet) with spacing along the row to give three different planting densities (about 150, 195 and 245 trees per acre) are compared with avenue planting (30 feet × 8 feet) and planting at 20 feet × 12 feet. The density treatments are:

Treatment Index	*Between rows feet*	*Within rows feet*	*Density trees/acre*
A	30	8	182
B(*i*)	50	6	145
B(*ii*)	50	$4\frac{1}{2}$	194
B(*iii*)	50	$3\frac{1}{2}$	249
C(*i*)	65	$4\frac{1}{2}$	149
C(*ii*)	65	$3\frac{1}{2}$	192
C(*iii*)	65	$2\frac{3}{4}$	244
E(*i*)	80	$3\frac{1}{2}$	156
E(*ii*)	80	$2\frac{3}{4}$	198
E(*iii*)	80	$2\frac{1}{4}$	242
D	20	12	182

The trial will occupy 48 acres and will be budded with four clones at two replications each, and eight replications of each spacing.

II(4) INFLUENCE OF SELECTIVE THINNING OUT

Estate Experiments

Experiments were laid down on 4 estates in 1937 to provide information concerning the number of trees (buddings and seedlings) that should be planted to the acre and the extent to which they should be thinned out with advancing age.

Each experiment was about 50 acres in extent and the original design provided for progressive thinning out from the third to the fifth years from budding or planting on two of the estates (No. 101 to 131). Three initial densities of planting clonal seedlings, namely 150, 279, 435 to the acre, and one planting density of buddings of clone Tjir 1, 150 to the acre, were to be compared and on two other estates (No. 136 and 146) four densities of planting of clones Pil B84 and PB 86 namely 150, 193, 257 and 302 trees to the acre were to be compared.

As no thinning out could be done during the Occupation a modified scheme has been adopted which consists of dividing each plot into two sub plots thinned out as shown below.

Original stand per acre (buddings)			150	193	257	302
,, ,, ,, ,, (clonal seedlings)			150	279	435	150*
Stand after final thinning out (buddings and clonal seedlings)	a		125	125	160	125
	b		125	160	180	125

* budded plots

The dates of thinning out on estates 101 and 131 are as follows:

Treatments	A	B	C	D*	*Estate 101 trees planted Sept 1937 – Jan 1938*	*Estate 131 trees planted Nov-Dec 1937*
Initial stand per acre	150	279	435	150		
First thinning on girth	-	-	300	-	Dec 1940	July 1941
Second ,, ,, ,,	-	180	220	-	Mar 1947	Mar 1947
Third ,, ,, yield (a)	125	125	160	125	June 1948	June-July '47
,, ,, ,, ,, (b)	125	160	180	125	,, ,,	,, ,, ,,

* budded plots

Tapping commenced in January, 1948 on Estate 101 and in April, 1947 on Estate 131. The other two estates are situated in disturbed areas and yields have not been recorded. Yield records for three years of tapping on Estate 101 and for two years on Estate 131 are presented in TABLE XXXII. As this is essentially a long term experiment comments will be reserved until more data become available.

II(5) MIXED PLANTING OF HEVEA AND OTHER CROPS

Work under this heading was carried out in cooperation with our Soils Division and with the Department of Agriculture.

An area of 13 acres was planted with *Hevea* seedling stumps along hedge rows one chain apart in late 1949. One half of the area was in the open and one half under light jungle. The rubber seedlings were budded in May 1951 with clones Tjir 1, RRIM 501 and PR 107. These clones were selected to observe the effect of light, medium and heavy crowns as shade plants.

In the Jungle section rentis rows 18 feet wide were prepared by poisoning for planting the hedges of rubber. Growth was naturally slower than in the open planting and in places budding could not be carried out. In such instances budded stumps were supplied.

Cacao basket plants grown from seed supplied by the Department of Agriculture were planted out in October 1949, in a series of observation plots receiving a number of different treatments for planting density, shade plants, artificial shading (palm leaves) and rate of jungle thinning. Considerable difficulty has been experienced throughout in establishing permanent shade trees for the cacao

TABLE XXX: ESTATE EXPERIMENTS ON METHOD OF PLANTING

Record of Yield and Girth

A: ESTATE 43 (*Coastal soil*)

Planted December 1938 field budding May 1940

Composition	*Planting material*	*Yield per cent*					*Girth at 50 in Dec 1951*
Polyclone	*Basket plants*	100	100		100	100	29.7 in
RRIM 500 Series	*Seedling stumps*	108	118	*Unrecorded*	109	113	29.6 in
Pil B84	*Budded stumps*	113	115		111	110	30.4 in
	Age from planting in years	10	11	12	13		13

B: ESTATE 165 (*Inland soil*)

Planted October-November 1938 field budding of seedling stumps November 1939 and germinated seed at stake April 1940

Composition	*Planting material*	*Yield per acre per year*								*To date*	*Girth at 50 in Oct 1950*
		lb/ac	%	*lb/ac*	%	*lb/ac*	%	*lb/ac**	%	%	
1. Polyclone	*Germinated seed*	709	100	670	100	791	100	1087	100	100	23.6 in
Tjir 1 Tjir 16	*Seedling stumps*	896	126	800	119	867	110	1114	102	113	24.9 in
Gl 1 PB 186	*Budded stumps*	1040	147	877	131	886	112	1107	102	120	25.4 in
	Stumped buddings	1099	155	847	126	847	107	1077	99	119	26.2 in
2. Monoclone	*Germinated seed*	663	100	783	100	974	100	1301	100	100	–
	Seedling stumps	841	127	932	119	1029	106	1351	104	120	–
Tjir 1	*Budded stumps*	847	128	939	120	1033	106	1277	98	119	–
	Stumped buddings	1114	168	1039	133	1065	109	1313	101	131	–
	Age from planting in years	9		10		11		12			12

* *Estimated annual yield from records for 7 months*

TABLE XXXI: DENSITY OF PLANTING EXPERIMENT

Field 14 C.D. R.R.I. Experiment Station

Plot index	*Planting distance ft*	*Trees/ acre*	*Girth measurements (in)*			*Tappable trees %*			*Av. trees in tapping/acre*			*Yield*						*Mean yield lb/acre/yr 1937-41 and 1946-51*
			1949	*1950*	*1951*							*lb/tree/yr*			*lb/acre/yr*			
			(year of age)															
			19	*20*	*21*	*1949*	*1950*	*1951*	*1949*	*1950*	*1951*	*1949*	*1950*	*1951*	*1949*	*1950*	*1951*	
A	30 × 30	48	43.8	44.8	45.7	93	93	92	46	46	45	16.5	17.8	22.3	757	812	1012	668
B	20 × 20	109	35.1	36.0	36.5	81	80	80	89	88	88	10.1	10.0	13.2	891	876	1162	759
F	20 △	125	32.6	33.4	33.9	86	85	85	109	108	108	8.8	7.9	10.8	956	857	1167	822
C	14 × 14	222	27.4	28.1	28.5	80	79	78	181	180	177	6.2	5.2	7.1	1125	940	1244	943
D	12 × 12	302	25.1	25.7	26.0	70	70	68	215	214	209	5.1	4.4	6.1	1102	931	1278	915
E	10 × 10	435	23.0	23.4	23.6	65	65	64	286	285	280	4.6	3.6	5.1	1307	1020	1425	1013

Planted: November 1930 with budded stump of clone AVROS 50.
New panel opened in July 1949 at 40 inches from the union on bark of first renewal.
Tapped on S/2.d/2.100% system.

TABLE XXXII: DENSITY OF PLANTING AND SELECTIVE THINNING OUT TRIALS

Yield expressed as percentage of the Control Density (A.a.b.)

Treatment		No. of trees per acre	YIELD Year of tapping 1	2	3	Mean	1	2	3	Mean	Mean yield 3 years	Mean girth (in) 50 inches from the ground		Mean thickness of virgin bark (mm)	
Estate 101 (coastal)			*Tjir 1 illeg seedlings*				*P.B.I.G. seedlings*				*All seedlings*	*Tjir 1 seedlings August '51*	*P.B.I.G. seedlings August '51*	*Tjir 1 seedlings*	*P.B.I.G. seedlings*
A	*a.b.*	125	100	100	100	100	100	100	100	100	100	32.5	30.8	9.6	9.3
B	*a.*	125	100	91	107	99	104	102	112	106	102	33.3	30.2	9.9	9.0
B	*b.*	160	113	108	115	112	110	115	120	114	111	31.5	28.9	9.6	8.6
C	*a.*	160	104	109	110	108	120	120	125	121	114	28.9	27.9	9.1	8.9
C	*b.*	180	112	116	114	114	126	127	125	126	120	28.5	27.2	9.0	8.5
D	*a.b.*	125	77	94	86	85	53	86	90	74	80	29.0	26.9	8.8	8.8
(Tjir 1 buddings)															

Estate 131 (inland)			*Seedlings from Field 5 R.R.I.E.S.*				*P.B.I.G. seedlings*				*Mean yield all seedlings*	*seedlings from Field 5 R.R.I.E.S. April '50*	*P.B.I.G. seedlings April '50*
A	*a.b.*	125	100	100		100	100	100		100	100	29.3	30.3
B	*a.*	125	105	103		104	113	114		114	109	29.4	29.2
B	*b.*	160	113	104		109	128	127		128	119	28.2	28.7
C	*a.*	160	135	121		128	129	134		132	130	28.0	28.9
C	*b.*	180	168	140	–	154	144	134	–	139	147	27.9	27.9
D	*a.b.*	125	105	100	–	103	104	99	–	102	102	27.6	27.9
(Tjir 1 buddings)													

Tapping systems
Estate 101 S/2.d/2.100'
Estate 131 S/1.d 4.100' *for 4 months of the first year; thereafter on* S 2.d 2.100'

between the rubber hedges. The original planting of *Parkia speciosa* failed. Supplying with seedlings stumps of *Gliricidia* was undertaken but was only partially successful.

A large proportion of the cacao seedlings in the open section have died and it is evident that the cultural methods applied are not suitable for their establishment. In the jungle area growth has been relatively good; flowering of the cacao has been plentiful and many plants have set fruit.

The following details of growth of cacao serve to show the status of the plants in the two areas.

November 1951	*Height of canopy*	*Diameter of stem at 20 cm height*	*Plants forking*
Trial I (Jungle)	160 cm	2.6 cm	75%
,, II (Open)	129 cm	1.9 cm	31%
,, III (Jungle)	173 cm	2.8 cm	70%
,, III (Open)	112 cm	1.6 cm	26%

II(6) METHOD OF NEW PLANTING AND REPLANTING BASED ON THE DESTRUCTION OF THE TREE BY POISONING

Replanting Experiment: Field 47

A randomised block trial of four replications was established in 1949 to compare different methods of reducing the unproductive period that occurs between cutting out the old rubber and bringing the new rubber into bearing. The following treatments are being compared:

A Fell the old rubber and replant. Planting distance 22ft × 11ft.

B Replant between existing rows and poison the old rubber nine months later. Planting distance 22ft × 11ft.

C Replant between existing rows and poison the old rubber eighteen months later. Planting distance 22ft × 11ft.

D Poison every third row of the old rubber and replant a double hedge along it with intervals of 6 ft between the two rows and of 5½ ft between the plants along the rows; the remaining stand of old rubber to be poisoned later.

Planting with seed at stake was carried out in September 1949 in all treatments. In treatment *A* the old trees were uprooted in June 1949 by means of a Trewhella winch which removed the stumps but only part of the root system. The seedlings attained the size suitable for budding in August 1951, twenty three months

after planting which is not abnormally long on the poor sandy loam of the flat area of the R.R.I. Experiment Station. They were budded with clone Tjir 1 and the stocks of successful buddings were cut back in October 1951.

In treatment *B* the old trees were poisoned in June 1950. The seedlings of the new stand were budded with clone Tjir 1 in November 1951, three months after those of the same age in treatment *A* although they had been growing for nine months under mature rubber and the stocks of successful buddings were cut back in January 1952.

In treatment *C* the old trees were poisoned in April 1951 (one month late owing to wintering). The seedlings of the new stand had failed to reach the standard size for budding by the end of 1951 and the retardation in growth was estimated as the equivalent of about nineteen months.

In treatment *D* the seedlings planted along every third row of the old rubber which had been poisoned in June 1949 have made slow progress in three plots out of four and it is doubtful whether they will be large enough for budding in 1952 in competition with the remaining rows of the old rubber trees, despite the root slicing which has been regularly carried out between the rows of old and new rubber plants.

Data of the yield obtained from the old rubber are presented in TABLE XXXIII.

TABLE XXXIII: REPLANTING EXPERIMENT FIELD 47 R.R.I. EXPERIMENT STATION

Treatment	*A*	*B*	*C*	*D*
Acreage	9.18	9.18	9.18	7.88
Mean yield 1951 (lb/acre)	*Budded October 1951*	–	128	272
Total crop July 1949 to Dec 1951 (lb/acre)		561	1007	893

Growth of the young seedlings has been measured at regular intervals; height measurements have been taken up to the ninth month of age and thereafter diameter measurements have also been taken at four inches from the ground (the normal height of budding). These data, presented in the graph in *Figure 1*, show that the beneficial effect on the young rubber plants of the removal

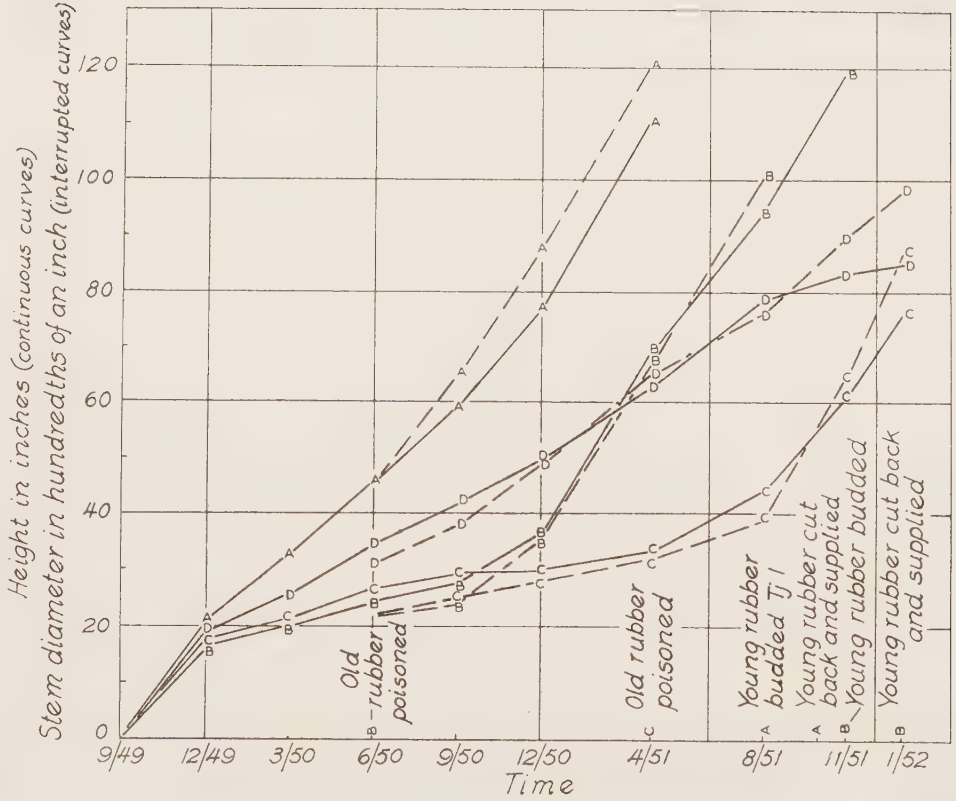

Figure 1. Replanting Experiment: Field 47, R.R.I. Experiment Station. Growth of the young rubber seedlings. Letters A, B, C, *and* D *refer to the four replanting treatments described in the text.*

of competition as a result of poisoning the old stand becomes apparent only after complete defoliation has taken place *i.e.* after about three months.

Poisoning of Rubber Trees with Sodium Arsenite

Observations were continued on Experiments 1 and 2 previously described*. In both, heavy branch fall started seven to nine months after poisoning and was almost complete in fifteen months. The trunk of some of the smaller trees fell between the eighth and fifteenth month.

Experiment 3† — A large scale experiment was set up on old seedling rubber, of mean girth of 57 inches, on an estate on coastal clay soil to investigate the effects of sodium arsenite solution at different strengths, the method of application, the effect of poisoning at different times of year, and the cost of treatment. The results showed the following:

(*a*) Frill girdling using $\frac{1}{2}$ pint of solution containing 5 lb sodium arsenite to 1 gallon water was as effective as stronger solutions, but reducing the volume of solution to $\frac{1}{4}$ pint per tree led to many failures, even when a solution of 10 lb sodium arsenite per gallon was used.

(*b*) Applying the poison in the form of a thin paste (the solution containing 6 oz tapioca starch per gallon) to an 8 or 12 inch ringbarked portion of the trunk was highly effective. Poisoning a four inch ringbarked portion of the trunk was not satisfactory.

(*c*) Doses of more than 2 oz sodium arsenite per tree, when applied to a ringbarked portion of the trunk, were unnecessarily high.

(*d*) Poisoning trees in the dry season (mid-August) gave a better percentage kill with a smaller dose than poisoning in wet weather in May, which, in turn, was more effective than poisoning in February, at the start of wintering. With a mean dose of 2 oz sodium arsenite per tree, however, even poisoning in February gave a kill of over 90%.

(*e*) Doses of less than 1.5 oz per tree gave extremely erratic results.

(*f*) The cheapest treatments which were reasonably effective (average kill 95% or over) were:

Eight inch ringbarking; poison paste containing 10 lb sodium arsenite and 6 oz tapioca starch to a gallon of water. Total cost per tree = 8.5 cents.

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* *Rep. Rubb. Res. Inst. Malaya* (1945-8) 74

† *Rep. Rubb. Res. Inst. Malaya* (1945-8) 74

Twelve inch ringbarking; paste containing 7½ lb sodium arsenite to a gallon of water. Total cost per tree – 9.8 cents.

A paste containing 5 lb sodium arsenite to a gallon of water gave kills of over 90% when applied to eight inch and twelve inch ringbarked portions of the trunk, at a cost of 6.3 and 8.2 cents per tree respectively.

Small scale trial on hilly inland clay soil — The following results were obtained with four strengths of sodium arsenite paste on an eight inch wide ringbarked portion of the stem of poorly grown old seedling rubber as shown in TABLE XXXIV.

TABLE XXXIV: PANEL POISONING OF OLD SEEDLING TREES

Treatment: (All solutions contain 12 oz tapioca starch per gallon)	*Average dose of sodium arsenite per tree oz*	*Total cost per tree cts*	*Percentage of trees killed*			
			3 mth	*6 mth*	*8 mth*	*12 mth*
10 lb sodium arsenite to 1 gal water	2.7	8.75	93	100	100	100
5 lb – ditto –	1.5	5.96	86	100	100	100
2 lb – ditto –	0.71	3.91	53	85	91	100
1 lb – ditto –	0.35	3.02	50	86	91	100

On this estate it was found that small trees (24 inches girth and less) were completetly killed within eight months by doses of sodium arsenite of 0.2 to 0.4 ounces per tree.

Reports are frequently received of alleged success with cheaper and simpler poisoning methods than those more commonly used. A small trial of two of these methods was started on an estate situated on peat clay soil in October 1949. Trees which had been slaughter tapped to the wood were divided into two groups.

TABLE XXXV: POISONING OF OLD SEEDLING TREES

Treatment	*No. of trees treated per gal of soln*	*Av. time to treat one tree*	*Approx. total cost per tree*	*Effect at four months from treatment. No. of trees:*		
				apparently healthy	*obviously affected**	*defoliated*
Spraying	26	2 *min*	8.7*c*	16	8	2
Painting	35	2 *min*	8.7*c*	17	18	0

* *Leaves drooping or partly shed*

One set was sprayed with a solution containing 5 lb sodium arsenite to a gallon of water, the other painted with a similar solution, the poison being applied in each case to four to six inches of the slaughter tapped panels. The results are shown in TABLE XXXV.

The proportion defoliated compares most unfavourably with the results obtained by ringbarking (eight or twelve inches) and applying a similar solution thickened slightly with tapioca starch at a cost of 6.2 to 8.2 cents per tree for the eight inch and twelve inch ringbarking treatments respectively.

Observations showed that panels slaughter tapped to the wood lying above the poisoned ring frequently prevented the upward movement of the poison.

The effect of tree poisoning on the roots of treated trees — Treatments were as follows:

(*a*) Trees killed by ringbarking and painting with sodium arsenite solution, 10 lb per gallon (plus 6 oz tapioca starch) in May, 1949.

(*b*) Trees killed by frill girdling and poisoning with 1/3 pint of 5 lb per gallon sodium arsenite solution in July 1949.

(*c*) Trees felled in August 1949: stumps ringbarked and painted with a 5 lb per gallon solution of sodium arsenite (plus tapioca starch) two to three weeks after felling.

(*d*) Trees felled in August 1949: stumps untreated.

Results of an examination of the lateral roots of trees in the different treatments are given below.

Treatment	*No. of roots examined*	*No. dead diseased*	*No. dead poisoned*	*No. dying poisoned*	*Percentage affected by poison*
a	40	12	7	1	20
b	42	3	7	3	24
c	59	7	50	2	87
d	50	5	0	0	0

It was noted that in group (*c*) not a single healthy root was found: only two roots were alive and these were poisoned in streaks and that in all poisoned trees and stumps the tap roots appeared to have been killed.

Arsenic content of poisoned trees — A tree killed by ringbarking and poisoning with a paste containing 3 oz sodium arsenite was felled six months after poisoning and sampled at intervals along the trunk and branches, both above and below the point of application. Accumulation of arsenic was found only in the region

immediately adjacent to the point of application. Other experiments have shown that leaves shed from a poisoned tree contain a high proportion of arsenic, while observation on a large number of poisoned trees suggests that the main channel of conduction of the poison is in the outer millimetre or two of the wood. It appears that the poison is rapidly drawn up by the transpiration current, killing the outer layers of the wood, the cambium and much of the adjacent bark, but is not retained in any measurable quantity and is finally accumulated in the leaves. The extra concentration in the area of application appears to be surplus poison that was not taken into the transpiration stream.

Poisoning of Rubber Trees with Substances other than Sodium Arsenite

In a previous report* only sodium arsenite out of a wide range of poisons tried was recorded as being effective in bringing about the death of trees. In 1949, the use of sodium chloride, copper sulphate. Izal and Brunolinum were found ineffective as tree poisons within nine months of application.

Since the discovery of an efficient chemical or preparation less dangerous to handle than sodium arsenite would be a great benefit, further substances have been examined. These were 'Ammate', 'Dicotox' (2-4D), sodium metabisulphite, sodium trichloracetate (T.C.A.), tar acid ('Lotemcide'), 'Fernoxone' (2-4D), dinitro-orthocresol (D.N.O.C.), 'Timbrol' (2-4D with pentachlorphenol), 'Santobrite' (pentachlorphenol) and copper sulphate calcium chloride paste. In three months about 6% of the treated trees were killed and in six months about 20%. Only 'Dicotox' at 100% strength and copper sulphate calcium chloride paste 4 lb and 8 lb respectively to 1 gallon of water) were entirely effective. Both substances were applied to an eight inch wide ringbarked strip.

III

TAPPING

TAPPING SYSTEMS ON SEEDLINGS AND BUDDED TREES

Tapping experiment No. 47 Field 6 R.R.I. Experiment Station† — The previous history of this trial which is our oldest experiment

* *Rep. Rubb. Res. Inst. Malaya* (1937) 120

† *Rep. Rubb. Res. Inst. Malaya* (1935) 78, (1933) 59, (1937) 98, (1938) 74, (1939) 102, (1940) 49, (1941-5) 10, 35, (1945-8) 75

TABLE XXXVI: TAPPING EXPERIMENT NO. 47

Tapping systems	*Mean No. of trees*	*Relative Yields*						
		Aug 1935 to Dec 1940	*May to Oct 1946*	*April to Dec 1947*	*Jan to Dec 1948*	*Jan to Dec 1949*	*Jan to Dec 1950*	*Jan to Dec 1951*
(*1*) *Control* S/2.d/2.100%	90	100	100	100	100	100	100	100
(*2*) *Double cut alternate-daily A.B.* 2S/2.d/2.3m/6.100%	180	104	91	87	110	98	90	95
(*3*) *Double cut fourth-daily* 2S/2.d/4.100%	90	117	118	112	135	111	98	101
(*4*) *Full spiral fourth-daily* S/1.d/4.100%	90	140	117	113	130	143	102	63

with full circumference tapping on seedling trees may be found in the references quoted.

Yields as percentage ratio to S/2.d/2.100% tapping, recorded up to the end of 1951 are given in the TABLE XXXVI.

In systems *2* and *3* the low cuts were tapped out in April-July 1949 and new high cuts opened on bark of first renewal. In system *4* the full spiral cut was tapped out during 1950 by gradually reducing the length of the cut from April onwards to a half spiral before the turnover. A new cut was opened about six inches above the previous opening on bark of first renewal in January 1951. These facts explain the decline in yield during 1950 and the very big drop in 1951.

The results for the period from which records are available show that under the conditions of the experiment, system *2* is the least satisfactory of the full circumference systems tested and that system *4* has retained a small advantage over system *3*.

Girth measurements of the trees at 50 inches from the ground in the different systems at the and of 1951 were:

S/2.d/2.100%	37.9 inches
2S/2.d/2.3m/6.100%	37.2 „
2S/2.d/4.100%	35.2 „
S/1.d/4.100%	36.9 „

*Tapping Experiment No. 48 Field 5 R.R.I. Experiment Station** — A straight comparison of the double four system with the half spiral alternate daily system on buddings of nine clones. All the clones in this trial with the exception of AVROS 50 have yielded less crop on the double four system than on the half spiral alternate daily system. The clones differ markedly in their response to the double four system; AVROS 49 and Pil A44 being affected the most adversely and AVROS 50 the least.

Yields expressed as percentage ratios are given in TABLE XXXVII.

The average girth of the trees at 50 inches from the union in December, 1950 was 34.5 inches on the S/2.d/2.100% system and 31.5 inches on the 2S/2.d/4.100% system.

Tapping Experiment No. 100 Field 18 R.R.I. Experiment Station† — This experiment was set up on 16 years old buddings of 16 clones to compare the full spiral fourth daily system (S/1.d/4.100%) with the standard half spiral alternate daily system (S/2.d/2.100%). The effect of S/1.d/4.100% tapping is shewn to have resulted during the four years of recording in less yield per

* *Rep. Rubb. Res. Inst. Malaya* (1935) 84, (1936) 62, (1937) 103, (1938) 78, (1939) 121, (1940) 62, (1941-5) 12, 35, (1945-8) 77

† *Rep. Rubb. Res. Inst. Malaya* (1945-8), 78

tree than that obtained from S 2.d 2.100% tapping. Yield data are presented in TABLE XXXVIII.

TABLE XXXVII: TAPPING EXPERIMENT NO. 48

Yield 2S/2.d./4.100% *system as percentages of the yield on control system* S/2.d/2.100%

Clones	*May-Oct 1946*	*May-Dec 1947*	*Jan-Dec 1948*	*Jan-Dec 1949*	*Jan-Dec 1950*	*Jan-Dec 1951*	*Mean for 6 years*
AVROS 49	58	56	57	48	50	43	52
AVROS 50	91	90	97	138	120	84	103
AVROS 152	87	73	83	94	79	68	81
BD 5	72	62	77	88	96	80	79
Pil A44	73	58	58	73	70	49	64
Pil B84	73	67	77	95	83	78	79
PB 23	81	79	81	85	82	70	80
PB 186	74	67	78	80	88	85	79
Tjir 1	63	57	74	101	97	69	77
Mean of all clones	75	68	76	89	85	70	77

The responses in 1948, 1950 and 1951 are alike and are in agreement with data from other similar trials. The reversal of the response during 1949 when the trees tapped on the S/2.d/2.100% system yielded much less than those tapped on the S/1.d/4.100% system can be accounted for by the panel position. In June 1949 a new half spiral panel was opened just above a five inch strip of renewed bark, the relic of an earlier experiment. The yield consequently dropped until this strip of bark was tapped off during the remainder of the year. In 1950 the panel was on virgin bark again and the yields recovered.

Tapping Experiment No. 101 Field 21 R.R.I. Experiment Station A comparison of four periodic full spiral fourth daily tapping systems and continuous fourth daily tapping on a full spiral cut set up in 1948 on 17 year old trees of seven clones. The record of yields is given in TABLE XXXIX.

Only one clone Tjir 16 has yielded in the third year more under the periodic systems than under the continuous system. It is noted that a very large decrease in yield under the latter occurred for which no explanation can be offered. Considered over the three years clone Tjir 16 has reacted the most favourably to the periodic systems and clone AVROS 50 the least favourably.

TABLE XXXVIII: TAPPING EXPERIMENT NO. 100

Year	*1948*		*1949*		*1950*		*1951*		*1948-1951*	
Tapping system	S/2.d/2. 100%	S/1.d/4. 100%	S/2.d/2. 100%	S/1.d/4. 100%	S/2.d/2. 100%	S/1.d/4. 100%	S/2.d/2. 100%	S/1.d/4. 100%	S/2.d/2. 100%	S/1.d/4. 100%
No. of trees tapped	1,380	1,865	1,347	1,818	1,308	1,750	1,261	1,735	–	–
Yield in pounds										
No. 1 sheet	27,086	32,797	16,008	27,228	17,096	22,049	17,293	19,380	77,483	101,454
Scrap & cup lump	2,218	5,386	2,914	4,773	3,079	4,559	2,874	5,044	11,085	19,762
Total	29,304	38,183	18,922	32,001	20,175	26,608	20,167	24,424	88,568	121,216
Lower grades as % of total	7.6%	16.4%	15.4%	14.9%	15.3%	17.1%	14.3%	20.7%	12.5%	16.3%
Mean yield per tree per year (lb)										
No. 1	19.6	17.6	11.9	15.0	13.1	12.6	13.7	11.2	14.6	14.1
Scrap & cup lump	1.6	2.9	2.1	2.6	2.3	2.6	2.3	2.9	2.1	2.8
Total	21.2	20.5	14.0	17.6	15.4	15.2	16.0	14.1	16.7	16.9
Mean d.r.c. of latex	39.2	39.0	42.0	39.3	40.1	39.2	42.2	44.9	40.9	40.6
Mean girth (in) at 40 in	30.3	30.1	30.8	30.5	31.1	30.6	31.4	30.7	–	–
Yearly girth increment (in)	–	–	0.48	0.36	0.36	0.13	0.28	0.12	0.37	0.20
Brown bast %	–	–	5.0	3.5	2.0	3.7	2.7	2.2	3.2	3.1

TABLE XXXIX: TAPPING EXPERIMENT NO. 101

Tapping system	S/1.d/4.100%				S/1.d/4. 8m/12.67%				S/1.d/4. 12m/16.75%				S/1.d/4. 12m/18.67%				S/1.d/4. 18m/24.75%				*Mean of periodic systems*			
Yield	*lb/tree*				*As percentage of* S/1.d/4.100%																			
Year	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Tjir 16	12.6	12.3	9.4	9.4	71	76	103	102	83	91	122	131	61	81	109	96	71	86	91	99	71	84	106	107
AVROS 71	19.1	21.1	19.9	22.4	65	67	70	62	66	69	71	70	73	65	57	71	65	74	68	71	68	69	66	69
BD 10	16.5	18.8	18.3	19.8	75	74	82	84	82	80	90	89	74	68	79	74	83	84	86	91	79	77	84	85
S Reko 9	9.9	8.0	8.4	7.7	56	66	60	64	70	84	82	84	53	65	54	70	62	81	76	78	60	74	68	74
AVROS 256	6.1	9.3	10.1	12.7	56	54	61	66	80	77	78	74	82	61	59	58	72	67	73	75	72	65	68	68
Cult 88	30.2	27.8	23.5	19.7	77	77	89	95	68	68	69	71	71	69	79	97	86	84	89	96	76	74	82	90
AVROS 50	19.0	22.6	28.0	28.8	51	53	50	55	50	50	47	55	56	58	55	65	60	62	59	65	54	56	53	60
Mean all clones	16.2	17.1	16.8	17.2	67	68	72	73	69	71	73	76	67	66	68	75	73	77	76	81	69	71	75	79
Mean over 4 years					70				72				69				77							

TABLE XL: TAPPING EXPERIMENT NO. 102

Tapping system	*Yield in lb/tree and as % of* S/1.d.4.100%								*Mean of 4 years* %
	First year		*Second year*		*Third year*		*Fourth year*		
	lb/tree	%	*lb/tree*	%	*lb/tree*	%	*lb/tree*	%	
S/1.d/4.100%	14.7	100	14.7	100	17.1	100	17.3	100	100
S/1.d/5.80%	11.5	78	11.7	80	14.8	87	15.0	87	83
S/1.d/6.67%	8.4	57	8.9	61	12.2	71	13.3	77	67

TABLE XLI: TAPPING EXPERIMENT NO. 103

Record of yield and girth

Tapping system		*A* S/2.d/2.100%						*B* S/3.d/1.24d/30.107%					
Year	*Period*	*Mean yield/tree/lb*			*Mean drc*	*Girth @ 50 in*	*Increment*	*Mean yield/tree/lb*			*Mean drc*	*Girth @ 50 in*	*Increment*
		No. 1	*No. 2*	*Total*				*No. 1*	*No. 2*	*Total*			
1st year	*May '48-Apr '49*	5.67	0.26	5.93	31.4	23.6 *in* (*June* '49)	--	7.65	0.25	7.90	31.0	23.1 *in* (*June* '49)	--
2nd year	*May '49-Apr '50*	5.90	0.20	6.10	32.4	24.9 *in* (*Dec* '50)	1.6	7.50	0.18	7.68	31.6	24.4 *in* (*Dec* '50)	1.3
3rd year	*May '50-Apr '51*	6.65	0.19	6.84	31.9	25.5 *in* (*Dec* '51)	0.6	7.00	0.16	7.16	31.7	25.1 *in* (*Dec* '51)	0.7
Mean yield		6.07	0.22	6.29				7.38	0.20	7.58			
Percentage ratio				100						121			

Note: Panel change in system B in August 1950

TABLE XLII: TAPPING EXPERIMENT NO. 106

Tapping system	S/1.d/4. 100%	S/1.d/3. 9m/12.100%	S/1.d/2. 2m/4.100%	S/2.d/2. 100% *(control)*
1950 Mean No. of trees tapped	159	158	156	156
Crop (lb) No. 1	3516	3368	2911	3201
Lower grade	773	481	370	499
Total	4289	3849	3281	3700
Lower grade as % of total	18.0	13.0	11.0	14.0
Yield/tree (lb) No. 1	22.1	21.3	18.7	20.5
Lower grade	4.9	3.0	2.4	3.2
Total	27.0	24.3	21.1	23.7
Yield as % of control	113	102	89	100
Mean d.r.c.	40.9	38.9	40.0	41.3
Brown bast %	0.6	0	2.6	1.9
1951 Mean No. of trees tapped	157	156	155	156
Crop (lb) No. 1	3147	3051	3017	3002
Lower grade	518	414	329	411
Total	3665	3465	3346	3413
Lower grade as % of total	14.1	12.0	10.0	12.0
Yield/tree (lb) No. 1	20.0	19.6	19.5	19.2
Lower grade	3.5	2.7	2.1	2.6
Total	23.5	22.3	21.6	21.9
Yield as % of control	107	102	99	100
Mean d.r.c.	41.5	41.2	41.3	42.5
Brown bast %	0	0	0	0.6
Mean for 1950-51				
Yield/tree (lb) No. 1	21.0	20.4	19.0	19.9
Lower grade	4.1	2.9	2.2	2.9
Total	25.1	23.3	21.2	22.8
Yield as % of control	110	102	96	100

*Tapping Experiment No. 102 Field 21 R.R.I. Experiment Station** — This is a small scale trial conducted on the same clones and on trees of the same age as in tapping experiment No. 101 (TABLE XXXIX). The trial is to investigate the effect of extending the interval between tappings on a full spiral cut from four to five and to six days.

TABLE XL shows the response to the different systems. The relative yields under d/5 and d/6 tapping show a regular increase which may be significant. These two systems however result in a higher total bark consumption owing to the deeper drying out of the tapping cut over the longer interval between tappings.

Tapping Experiment No. 103 Ulu Klang smallholding — This is a small scale trial established in 1948 on a mixed stand of clones Tjir 1 and Pil B84, budded between December, 1938 and November, 1940. The tapping is to compare the standard system of S/2.d/2.100% against S/3.d 1.24d 30.107% which approximates to a tapping system commonly used on small holdings. TABLE XLI gives the record of yields for the past three years.

The smallholders' system has consistently given more crop than the normal S/2.d/2 system. The excess over S/2.d/2 tapping was 37% in 1949, 8% in 1950 and 15% in 1951.

Bark consumption has been 1.1 inches per month under S/2.d/2 tapping and 1.8 inches per month under the smallholders' system. At these rates the panel cycle would be complete in 72 and 66 months respectively on 40 inch panels.

Tapping Experiment No. 106 Field 22A R.R.I. Experiment Station — This experiment is to compare three full spiral systems of 100% intensity with the S/2.d/2.100% system. It is carried out on mixed buddings which were 17 years old at the beginning of the trial in November, 1949. Records for 1950 and 1951 are presented in TABLE XLII. Trees in S/1.d/4.100% tapping gave the best yield per tree relative to the control system in both years, in 1950 by an appreciable amount and by a smaller amount in 1951. The major portion of the increase in crop was in the lower grade rubber.

Tapping Experiment No. 108 Estate Experiment — The full spiral fourth daily tapping system has two major drawbacks: the rate of growth of young trees is reduced, and frequently the proportion of cup lump is high compared with that of trees tapped on the half spiral alternate daily system. It is possible that the introduction of suitable resting periods in full spiral systems will have beneficial effect in this connection.

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* *Rep. Rubb. Res. Inst. Malaya* (1945-8) 80

TABLE XLIII: TAPPING EXPERIMENT NO. 108

Table of yields for first year of tapping April 1950 to March 1951

Tapping system	*Yield/tree/tapping* lb	*Yield/ac/annum* lb	%	*Yield per tapper* lb	*Relative tapping cost* %
S/2.d/2.100%	0.038	826	100	13.42	100
S/2.d/2.(2x6m/12). 100%	0.040	856	104	13.92	96
S/2.d/2.(2x12m/24). 100%	0.038	829	100	13.48	100
S/1.d/2.2m/4.100%	0.079	840	102	18.89	71
S/1.d/4.100%	0.088	945	114	21.26	63
S/1.d/4.100%	0.093	989	120	22.26	60
S/1.d/4.9m/12.75%	0.088	702	85	21.05	64
S/1.d/4.18m/24.75%	0.092	733	89	21.99	61
S/1.d/4.36m/48.75%	0.091	725	88	21.76	62
S/1.d/4.8m/12.67%	0.084	599	73	20.22	66
S/1.d/4.16m/24.67%	0.086	616	75	20.78	65
S/1.d/4.32m/48.67%	0.088	618	75	20.85	64
S/1.d/3.9m/12.100%	0.091	973	118	21.82	62
S/1.d/3.12m/16.100%	0.091	977	118	21.91	61
S/1.d/3.15m/20.100%	0.086	923	112	20.69	65

This experiment, designed to study these features and the effect of periodic change over of tapping panels from trees tapped on the half spiral alternate daily system, was set out on 38 acres of 9 years old buddings of clone Tjir 1 on a collaborating estate. It has randomised block design with 4 replications of each treatment. The following treatments are being compared:

S/2.d/2.100%, the standard system	
S/2.d/2.(2x6m/12.)100%,change over every sixth month S/2.d/2.(2x12m/24).100%, change over every twelfth month	100% S/2.d/2 system
S/1.d/2.2m/4.100%	100% S/1.d/2 system
S/1.d/4.100% S/1.d/4.100%	100% S/1.d/4 systems
S/1.d/4.9m/12.75% S/1.d/4.18m/24.75% S/1.d/4.36m/48.75%	75% S/1.d/4 systems
S/1.d/4.8m/12.67% S/1.d/4.16m/24.67% S/1.d/4.32m/48.67%	67% S/1.d/4 systems

S/1.d/3.9m/12.100%
S/1.d/3.12m/16.100% 100% S/1.d/3 systems
S/1.d/3.15m/20.100%

The results for the first year of recording are given in TABLES XLIII and XLIV.

TABLE XLIV: TAPPING EXPERIMENT NO. 108

Table of girths, brown bast incidence and bark consumption of trees tapped from April 1950 to March 1951

Tapping system	*Girth in inches at 55 in above union*		*B. bast April '50/ March '51*	*Bark consumption inches April '50 March '51*
	March '51	*Increase*		
S/2.d/2.100%	24.6	1.1	2	6.9
S/2.d/2.(2x6m/12). 100%	24.5	1.0	1	7.2
S/2.d/2.(2x12m/24). 100%	24.4	1.1	–	7.0
S/1.d/2.2m/4.100%	24.3	1.1	10	3.7
S/1.d/4.100%	24.0	1.1	1	4.1
S/1.d/4.100%	24.2	0.9	–	4.1
S/1.d/4.9m/12.75%	24.4	1.1	1	3.1
S/1.d/4.18m/24.75%	24.5	1.1	2	3.1
S/1.d/4.36m/48.75%	24.8	1.3	–	3.1
S/1.d/4.8m/12.67%	24.6	1.2	–	2.9
S/1.d/4.16m/24.67%	24.4	1.4	–	2.8
S/1.d/4.32m/48.67%	24.0	1.5	–	2.8
S/1.d/3.9m/12.100%	24.2	1.0	3	3.8
S/1.d/3.12m/16.100%	24.6	1.0	–	4.0
S/1.d/3.15m/20.100%	24.1	1.1	6	3.9

As short term results are of little value in an experiment of this nature comment will be reserved until more data are available.

Tapping Experiment No. 110 Field 4A R.R.I. Experiment Station — An experiment has been set up in a field of high yielding legitimate and illegitimate clonal seedlings in which there is a high brown bast incidence (22%) to study the effect of tapping treatments on the trend of brown bast incidence and of yield. Tapping treatments are;

A S/2.d/2.100% – brown bast affected trees to be rested for six months

B S/2.d/2.100% – trees showing symptoms of brown bast to be tapped alternate daily on a third spiral cut S/3.d/2.67%

TABLE XLV: TAPPING

Yields lb/acre/year and as

Tapping system		*A* S/2.d/2.100%			
Estate		*28*	*41*	*16*	*159*
Clones	*Year of tapping*	*Yield lb/ac/year*			
PB 86	1	174	1054	925	–
	2	1068	914	967	–
	3	964	1115	1039	–
	4	993	–	1038	–
PB 186	1	378	842	–	–
	2	674	661	–	–
	3	778	807	–	–
	4	749	–	–	–
Gl 1	1	873	1614	–	–
	2	1127	1093	–	–
	3	1044	895*	–	–
	4	917	–	–	–
Pil D65	1	476	795	651	–
	2	716	675	718	–
	3	792	792	824	–
	4	716	–	714	–
BD 5	1	286	601	–	–
	2	452	523	–	–
	3	565	654	–	–
	4	589	–	–	–
Tjir 1	1	–	–	908	–
	2	–	–	789	–
	3	–	–	960	–
	4	–	–	1004	–
Tjir 16	1	–	–	928	–
	2	–	–	1123	–
	3	–	–	1169	–
	4	–	–	987	–
Pil B84	1	442	755	668	975
	2	705	654	728	1290
	3	781	781	823	1132
	4	703	–	799	1309
P.B.I.G. seedlings	1	–	–	–	1604
	2	–	–	–	1684
	3	–	–	–	1321
	4	–	–	–	1826

Estate 41. Gl 1 tapping intensities reduced in the

* S/2.d/3.67%
† S/2.d/4.50%
‡ S/2.d/4.50%

percentage of the yield on S/2.d/2.100%

B S/1.d/4.100%

28		*41*		*16*		*159*	
Yield as	*% of A*	*Yield as*	*% of A*	*Yield as*	*% of A*	*Yield as*	*% of A*
757	106	1184	112	725	78	–	–
1170	110	788	86	758	78	–	–
1051	109	917	82	946	91	–	–
942	95	–	–	956	92	–	–
402	106	890	106	–	–	–	–
771	114	681	103	–	–	–	–
831	107	764	95	–	–	–	–
730	97	–	–	–	–	–	–
798	91	1113	69	–	–	–	–
1002	89	569	52	–	–	–	–
958	92	588†	66	–	–	–	–
877	96	–	–	–	–	–	–
515	108	927	117	586	90	–	–
899	126	610	90	685	95	–	–
903	114	668	84	710	86	–	–
784	109	–	–	692	97	–	–
285	100	700	116	–	–	–	–
507	112	525	100	–	–	–	–
611	108	603	93	–	–	–	–
605	103	–	–	–	–	–	–
–	–	–	–	744	82	–	–
–	–	–	–	856	92	–	–
–	–	–	–	922	96	–	–
–	–	–	–	1038	103	–	–
–	–	–	–	660	71	–	–
–	–	–	–	853	76	–	–
–	–	–	–	853	73	–	–
–	–	–	–	862	87	–	–
516	116	797	106	564	84	908	93
852	121	491	75	528	73	927	72
819	105	578	74	544	66	836	74
741	105	–	–	555	69	793	58
–	–	–	–	–	–	1433	89
–	–	–	–	–	–	1530	91
–	–	–	–	–	–	1301	98
–	–	–	–	–	–	1431	78

fourth month of the third year to

TABLE XLV: (*cont.*) TAPPING
Yields lb/acre/year and as

Tapping system		*C* 2S/2.d/4.100%			
Estate		*41*		*159*	
Clones	*Year of tapping*	*Yield*	*as % of A*	*Yield*	*as % of A*
PB 86	1	1343	127	–	–
	2	909	99	–	–
	3	986	88	–	–
	4	–	–	–	–
PB 186	1	1011	120	–	–
	2	698	106	–	–
	3	662	82	–	–
	4	–	–	–	–
Gl 1	1	1424	88	–	–
	2	777	71	–	–
	3	500‡	56	–	–
	4	–	–	–	–
Pil D65	1	973	122	–	–
	2	652	97	–	–
	3	569	72	–	–
	4	–	–	–	–
BD 5	1	683	114	–	–
	2	577	110	–	–
	3	616	94	–	–
	4	–	–	–	–
Tjir 1	1	–	–	–	–
	2	–	–	–	–
	3	–	–	–	–
	4	–	–	–	–
Tjir 16	1	–	–	–	–
	2	–	–	–	–
	3	–	–	–	–
	4	–	–	–	–
Pil B84	1	918	122	1063	109
	2	665	102	1122	87
	3	615	79	966	85
	4	–	–	929	71
P.B.I.G. seedlings	1	–	–	1629	101
	2	–	–	1707	101
	3	–	–	1451	110
	4	–	–	1542	84

Estate 41. Gl 1 tapping intensities reduced in the

* S/2.d/3.67%
† S/2.d/4.50%
‡ S/2.d/4.50%

EXPERIMENTS ON ESTATES

percentage of the yield on S/2.d/2.100%

A S/2.d/2.100%				*B* S/1.d/4.100%				*C* 2S/2.d/4.100%	
28	*41*	*16*	*159*	*28*	*41*	*16*	*159*	*41*	*159*
				% brown bast of trees in tapping					
–	1	–	–	–	4	–	–	3	–
–	1	–	–	–	10	–	–	5	–
2	1	1	–	2	5	5	–	–	–
7	–	2	–	7	–	6	–		
	2	–	–	–	2	–	–	4	
–	5	–	–	–	1	–	–	4	–
1	3	–	–	2	3	–	–	4	–
6	–	–	–	5	–	–	–	–	–
–	3	–	–	–	13	–	–	8	–
–	10	–	–	–	21	–	–	29	–
9	7*	–	–	9	8†	–	–	20‡	–
23	–	–	–	18	–	–	–	–	–
		–	–	–	4	–	–	2	–
–	4	–	–	–	4	–	–	15	–
3	2	5	–	1	5	3	–	11	–
15	–	10	–	13	–	3	–	–	–
–	–	–	–	–	3	–	–	2	–
–	4	–	–	–	5	–	–	1	–
1	–	–	–	–	2	–	–	1	–
5	–	–	–	6	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	6	–	–	–	5	–	–	–
–	–	2	–	–	–	5	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	3	–	–	–	3	–	–	–
–	–	1	–	–	–	6	–	–	–
–	1	–	–	–	4	–	–	5	–
–	2	–	–	–	11	–	–	10	–
2	–	1	5	4	5	4	3	2	4
10	–	3	14	11	–	4	21	–	24
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	2	–	–	–	3	–	9
–	–	–	11	–	–	–	16	–	19

fourth month of the third year to

C S/2.d/3.67% – brown bast affected trees to be rested for six months.

Recording will commence in 1952.

Tapping experiments on estates — Four tapping experiments are being conducted on areas of experimental planting established before the war under the Rubber Regulation scheme. Yield records for four years of tapping in three of the experiments and for three years in the fourth are given in TABLE XLV.*

The response to S/1.d/4 the full spiral fourth daily system and to the double four system 2S/2.d/4.100% is in general very much poorer than to S/2.d/2 the half spiral alternate daily system. On Estate 28, where with the exception of clone G1 1, full spiral tapping had given higher yields than half spiral tapping for the first three years, the yields from the two systems were about equal in the fourth year of tapping.

Brown bast incidence has been very slightly higher in the S/1.d/4 system than in the S/2.d/2 system. Double four tapping has also resulted in a higher incidence of brown bast.

Clone G1 1 is shown to be particularly ill suited to full circumference tapping as regard yield and brown bast incidence.

TABLE XLVI: SLAUGHTER TAPPING TREATMENTS

Treatments	*Tapping system*	*Period of tapping*	*Type of tapping cuts*
A	2C/1.d/3.267%	18 *months*	1 *high V/1 cut tapped upwards* 2 *low S/2 cuts tapped downwards*
B	3S/2.d/3.200%	18 *months*	1 *high V/1 cut tapped upwards* 1 *low S/2 cut tapped downwards*
C	(2C/1.d/4.200% (2C/1.d/2.400%	12 *months* 6 „	1 *high V/1 cut tapped upwards* 2 *low S/2 cuts tapped downwards*
D	2C/1.d/4.200%	18 *months*	*ditto*
E	(2C/1.d/4.200% (2C/1.d/3.267% (2C/1.d/2.400% (2C/1.d/1.800%	4 *months* 4 „ 3 „ 1 „	*ditto*
F	(2C/1.d/3.267% (2C/1.d/2.400%	9 *months* 3 „	*ditto*
G	2C/1.d/2.400%	6 *months*	*ditto*
H	S/2.d/2.100% (*Control*)	18 *months*	1 *S/2 cut tapped downwards*

* *Rep. Rubb. Res. Inst. Malaya* (1945-8) 80. *Yield data given in* TABLE XXIX *are amended in this report by the addition of lower grade harvest to the record for estate 16 and by the correction of a computation error in the record for estate 41*

SLAUGHTER TAPPING EXPERIMENTS

Tapping Experiment No. 109 Field 16N R.R.I. Experiment Station — A slaughter tapping experiment to include upward tapping has been set up on 24 year old seedling trees in Field 16 of the R.R.I. Experiment Station. Tapping treatments are compared in TABLE XLVI.

Each treatment is divided into two sub-treatments, one of which will receive an application of a yield stimulant to a three inch strip of lightly scraped bark below the downward cut or above the upward cut every four months.

Only pretreatment recording was undertaken in 1951 to obtain data of covariance. Slaughter tapping will begin in 1952.

IV

PHYSIOLOGY

NUTRITION

As described in the Report for 1945-1948, pages 83-84, the injection experiment on clone BD 5 gave no positive result. In connection with this experiment, however, further work was carried out.

That clone BD 5 suffers from chronic defoliation in Malaya has long been known, and various speculations have been made as to the immediate cause. Controlled observations carried out at the R.R.I. Experiment Station have shown that the clone suffers from an exceptionally heavy premature leaf fall, and that shoots which lose their leaves in this way very frequently die completely. The premature leaf fall is always associated with one or more of the following: *Oidium heveae*, *Gloeosporium alborubrum* or mites, (*Hemitarsonemus latus*).

Extremely heavy sulphur dusting failed to control the condition. This might be held to indicate that none of these three organisms is responsible for the defoliation. However, since subsequent observations carried out by the Pathological Division have shown that the growth of *Gloeosporium alborubrum* is but slightly affected by sulphur the part played by this fungus is still a matter for question.

IV(2) PHYSIOLOGY OF LATEX FLOW IN RESPONSE TO TAPPING

Effect of Tapping on the Latex in the vessels – The results of a number of experiments have been collected and a detailed account

has been published* but the following summarises the main results. During periods of continuous tapping total solids remain more or less constant both in latex in situ and in tapped latex. Relatively small changes in total solids and in dilution take place, mainly attributable to seasonal conditions (wet or dry spells). Heavy showers of rain during the dry season lead to transient effects, causing an increase in dilution of the latex on tapping and a greater volume of tapped latex during the day or two following the shower. Showers in the wet season have no individual effect.

Wintering brings about complex changes in the total solids and dilution of the latex. The reduction in volume of latex obtained on tapping at the time of refoliation does not appear to be associated with excessive transpiration, as is often stated, but is associated with a period of growth first of the production of the new leaves, and subsequently in diameter of the trunk. Recovery of latex yield after wintering is associated with a decrease in the rate of growth of the trunk.

The effect of tapping is transmitted downwards and horizontally from the cut with a definite time lag, taking between five and ten minutes to cover one foot vertically and between fifteen and thirty minutes to cover eight to nine inches laterally. The whole lower portion of the trunk may be affected by tapping within two hours after opening the cut; dilution was found to have taken place at points all around the trunk at six feet from ground level in one series of experiments.

In trees brought into tapping for the first time, or after a long rest, dilution appeared in the branches of the crown, thirty feet from the ground, after three tappings. On theoretical grounds dilution of the latex at any point implies that there is, or has been, a flow at that point towards the tapping cut. The conclusion is drawn that latex flows from the whole branch system to the tapping cut. Further, if the hypothesis is correct that rubber formation will proceed when the latex becomes diluted below its 'normal' level, tapping induces rubber formation throughout the whole latex system of the tree, not solely in a relatively small area mainly below the tapping cut.

Nature of the diluent — An attempt was made to determine whether the liquid which dilutes latex on tapping is water or a solution, by making accurate measurements of latex total solids

* RICHES, J.P. and GOODING E.G.B. *New Phytologist* 51 (1952) 1
GOODING, E.G.B. *New Phytologist* 51 (1952) 11
GOODING, E.G.B. *New Phytologist* 51 (1952) 139
GOODING, E.G.B. *New Phytologist* 51 (1952) 258

and DRC on successive samples flowing from the cut. It was found that there was a definite increase in the ratio of solids to rubber in the latex during the tapping flow and that this increase was significantly greater in the early than in the later samples. This is consistent with the theory that in the early stages of latex flow, when dilution is rapid, the diluent is a solution, but that during the later stages, when dilution is comparatively small, the diluent is water or a very dilute solution. On the other hand a similar result could be obtained if the latex became contaminated with sieve tube contents during its flow, or if non-rubber solids, adsorbed on caoutchouc particles, were released into the serum as a result of increasing aqueous dilution.

Experiments to Study the Paths of Translocation of Nutrients and/or Latex

Tapping Experiment No. 104 Field 23 R.R.I. Experiment Station - A small scale experiment to study the effect on the yield of trees tapped on a full spiral cut by deliberate interruption of possible paths of translocation of food materials or latex or both down the stem towards the tapping cut was set up on 20 seedling trees in Field 23, R.R.I. Experiment Station in 1949.

The interruption of downward flow in the bark caused by ringing a tree above the tapping panel leads to a rapid decline in the yield of latex*. In full spiral tapping, yields are maintained for long periods despite the partial ringing effect of the full circumference cut and this being the case, conduction must be taking place vertically downwards in the thin layer of bark remaining between the tapping cut and the cambium. It may also take place laterally between the upper and lower ends of the tapping cut.

Three possible paths of translocation in trees tapped fourth daily on a full spiral cut have been interrupted by the following treatments:

(*i*) Full spiral cut is tapped to the wood.

(*ii*) Full spiral cut is tapped to normal depth (about 1½ mm from the wood) but the ends of the cut are joined by a vertical cut to the wood. This cut is re-opened once a month and extended as fast as the tapping cut progresses down the tree.

(*iii*) A combination of (*i*) and (*ii*).

(*iv*) Control. Normal S/1.d/4.100% tapping.

Preliminary yields on the S/1.d/4.100% system were recorded for two months on 20 trees which were then arranged into four treatment groups of 5 trees each, in such a way that the total yields

* BOBILIOFF, W. *Arch. Rubbercult. Ned.-Ind.* 4 (1920) 247

TABLE XLVII: TAPPING EXPERIMENT NO. 104

Yields expressed as a percentage of the control (treatment iv)

Treatment	*Jan*	*Feb*	*March*	*April*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*	*Mean yield*
1949													
i							101	129	103	87	63	76	89
ii							99	114	118	98	98	104	106
iii							107	120	64	60	39	37	62
iv							100	100	100	100	100	100	100
1950													
i	80	87	84	95	76	90	83	108	91	100	78	79	86
ii	108	102	106	124	131	136	132	142	129	143	120	112	116
iii	31	28	28	27	20	30	18	14	13	13	9	8	35
iv	100	100	100	100	100	100	100	100	100	100	100	100	100
1951													
i	79	93	101	86	85	79	75	77	82	77	74	92	85
ii	111	112	102	88	98	98	94	101	112	109	100	90	110
iii	6	12	7	7	5	5	4	4	3	4	3	3	23
iv	100	100	100	100	100	100	100	100	100	100	100	100	100

Treatments were applied in August 1949 after two months of yield recording.

were approximately the same in each group when the treatments were applied on 1 August 1949.

The results up to the end of 1951 are shown in TABLE XLVII.

Tapping to the wood on the full spiral cut (treatment (*i*)) would seem to check downward translocation. Tapping to the normal depth but joining the ends of the full spiral cut by a vertical cut to the wood (treatment (*ii*)) provides no evidence for lateral translocation. The apparent increase in yield would seem to be fortuitous and may be due to the small number of trees used in the experiment. Complete ringing by cuts down to the wood (treatment (*iii*)) causes a very large decrease in yield.

The implication based on the results of treatments (*i*) and (*ii*) is that in full spiral tapping, conduction of food material or latex, (or both) is normally vertical, and takes place in the thin inner layer of 'bark' left after tapping. Treatment (*iii*) which results in a far more rapid and severe reduction in yields than treatment (*i*) provides evidence of lateral translocation when the normal channels of conduction are severed.

Tapping Experiment No. 104A Field 2 R.R.I. Experiment Station — This experiment compares the same tapping treatment used in experiment 104 but is carried out on a larger number of trees.

Only pretreatment recording was undertaken in 1951. The treatments will be applied in 1952.

IV(3) FUNDAMENTAL RESEARCH ON LATEX PHYSIOLOGY

*Methods of extraction and estimation of rubber in hevea plant material** – The Head of Division spent four months of study leave (May to August, 1949) at the Botany School, University of Cambridge, to familiarise himself with the new 'Cold Solvent' method for rubber estimation developed by Dr J.P.R. Riches in the course of earlier work for the British Rubber Producers' Research Association. A joint investigation was carried out with Dr Riches during Dr Baptist's stay in Cambridge.

Seeds of clone PB 86 sent from Malaya were germinated in the tropical pit of the Cambridge Botanic Garden and the seedlings were used in an investigation to verify the results obtained by DE HAAN and VAN AGGELEN-BOT†. These authors had shown that during the first three weeks after germination the ratio of total

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* *See also Section I* (4)

† DE HAAN, I. and VAN AGGELEN-BOT, G.M. *Arch. Rubbercult. Ned.-Ind.* 26 (1949) 121

rubber content to dry matter present in the developing embryo remained approximately constant no matter whether the seedlings were growing in the light or in the dark and suggested that rubber formation might be associated with some growth process in the plant, the rubber hydrocarbon arising as a by-product from precursors derived from endosperm reserves.

These results have been confirmed by E.D.C. Baptist and J.P. R. Riches who showed that rubber accumulates in young *Hevea brasiliensis* seedlings growing in the light or in the dark, the ratio of rubber hydrocarbon to the fresh weight or the dry weight of the embryo remaining approximately constant from the first to the fourth week after germination.

They also found in feeding experiments that appreciably larger amounts of rubber hydrocarbon accumulate in the tissues of etiolated seedlings growing in sand by adding acetate to the culture solution thus confirming the results obtained with guayule seedlings by BONNER and ARREQUIN*.

The increased rubber content was located largely in the fraction soluble in cold benzene (low molecular weight rubber). No increase in rubber content was obtained by feeding with glycerol. It has been intended to repeat the feeding experiments using rooted cotyledons as it had previously been found at this Institute that cotyledonary stalks of a germinating seed severed from the axis of the developing seedling would develop root initials from the callus formed at the cut ends and that better rooting was obtained during the early stages of seedling growth when the endosperm reserves have not yet diminished appreciably.

The paired cotyledon technique would have been very valuable for use with these feeding experiments but there was not a sufficient number of rooted cotyledons available to allow completion of the experiments which had been planned.

As rooted *Hevea* leaves would be extremely suitable in investigations on the metabolism of laticiferous tissues an attempt was made to promote rooting from the cut end of the petioles of detached leaves. The leaves were severed at the base of the pulvinus which was just immersed for 24 hours in solutions of indolylbutyric acid 1 p.p.m. and 4 p.p.m. in distilled water inorganic culture (O.P. 0.2 atm.), sucrose (2%) and of a mixture of sucrose (2%) and asparagin (0.2%).

After treatment the leaves were transferred to tubes containing water and kept at a temperature of 30°C. No adventitious root formation was obtained in water or in moist sand.

* BONNER, J. and ARREQUIN, B. *Arch. Biochem.* 21 (1949) 109

On the other hand a healthy leaf collected from a seedling by pulling sharply and inducing a clean break at the base of the pulvinus and planted in a frame of the tropical pit at the Botanic Garden, with petiole embedded some 2 cm deep in a mixture of sand and peat had developed at four weeks from planting a layer of callus at the surface of which root initials were forming and one root had grown to a length of 5 cm. This is believed to be the first case on record of a detached *Hevea* leaf producing roots.

IV(4) INFLUENCE OF INJECTED SUBSTANCES ON YIELD AND PROPERTIES OF LATEX

An experiment designed to study the effect of copper salts and copper complexing agents on yield and on the properties of latex and rubber when they are injected into the stem of *Hevea* trees has been set up in Field 4A, R.R.I. Experiment Station.

The following treatments will be used and the chemicals will be inserted in auger holes at one per tree bored at about half an inch to the side of the top end of the tapping cut.

i	Copper sulphate ($CuSO_4 .5H_2O$)	10 gm
ii	Copper nitrate ($Cu(NO_3) .6H_2O$)	10 gm
iii	Sodium sulphate	5 gm
iv	Copper oleate	12 gm
v	Sodium diethyl dithiocarbamate	10 gm
vi	Sodium ethylene diamine tetra-acetate (Versene)	10 gm
vii	Distilled water	
viii	No holing but light scraping of 3 inch strip of bark below tapping cut	
ix	Control – no treatment	

Treatment *ii* is for comparison with Cu ions in treatment *i*.

„ *iii* „ „ „ „ SO_4 „ „ „ *i*.

„ *iv* is to study the effect of a slightly ionising copper compound.

„ *v* & *vi* are to study the effect of copper complexing agents.

The following tests will be carried out in the Chemical Division:

1	Dry rubber content and total solids	on latex preserved by ammoniation to 0.5% ammonia
2	Copper content	
3	Mechanical stability	on centrifuged concentrate of latex
4	KOH number	
5	Viscosity	
6	Vulcanization tests on dry rubber	

The layout of the experiment provides for 25 blocks each of nine trees with the nine treatments allotted at random in each block.

Individual tree yields have been recorded since 1 October 1951 and collections of latex have been made for the Chemical Division. The treatments will be applied early in January 1952.

IV(5) LATEX YIELD STIMULATION

Yield stimulation experiment M. 39 Jungle Plot 'B' R.R.I. Experiment Station – Twenty year old seedling trees which had been in tapping for only one and a half years prior to the commencement of this trial were subjected to treatment by the following chemicals at a concentration of 0.1% in a water/liquid paraffin emulsion.

A 3 – indolylbutyric acid
B 1 – naphthalene acetic acid
C p – chlorophenoxyacetic acid
D 2 – naphthoxyacetic acid
E alpha – (2 – naphthoxy) propionic acid
F 1 – naphthoxyacetic acid

The emulsions were applied to trees on a 3 inch wide strip of bark immediately below the tapping cut. Both scraped and unscraped bark were treated. Tapping was S/2.d/2.100%. No evidence of a marked superiority of any treatment over the control (no scraping, no chemical applied) was recorded while the 3 inches of treated bark was tapped out over a period of about $3\frac{1}{2}$ months.

A second set of treatments with the following chemicals was applied to these trees. The yield in grams of dry rubber per tree per tapping from each treatment for two months after application is shown in TABLE XLVIII.

These early results do not confirm the very large increases in yield obtained in the R.R.I. pre-war experiments* as a result of scraping alone and of application of palm oil to scraped bark. They indicate that the same order of yield increase may be obtained with the two proprietary yield stimulants tested and with palm oil containing 10,000 p.p.m. of the sodium salt of 2,4-dichlorophenoxyacetic acid.

Yield stimulation experiment M.39B Field 14 E (i), R.R.I. Experiment Station — An experiment on 20 year old seedlings and 19 year old buddings of PB 186 has been designed using the following treatments:

Treatment *A* Proprietary yield stimulant A
B Proprietary yield stimulant B

* *Rep. Rubb. Res. Inst. Malaya* (1941-5) 28

C Palm oil

D Palm oil + 1% of the sodium salt of 2,4-dichlorophenoxyacetic acid (2,4-D

E Palm oil + 1% sodium salt of 2,4-D + 1% sulphur

F Palm oil + 1% sodium salt of 2,4,5-trichlorophenoxyacetic acid

G Copper sulphate in auger hole (10 grams)

H Scraping only

O Control (no treatment)

Treatments *A* to *F* will include scraping of a 3 inch wide strip of bark immediately below the tapping cut just prior to the application of the compounds. The extent of scraping in treatment *H* will also be 3 inches.

Individual tree recording was begun in December 1951. Treatment will commence in 1952.

IV(6) STIMULATION OF BARK RENEWAL

Experiment M.35/1 Field 12 R.R.I. Experiment Station — A large scale experiment using sebacic acid, thiourea and glutathione at concentrations of 0.001%, 0.01%, 0.1%, 1% and 10% in water-in-oil emulsions is being conducted. The treatments are applied to a 3 inch wide strip of tapped bark immediately above the tapping cut. At the end of 1951, 8 months after the first application was given, no treatment had induced any significant response in the rate of renewal of bark.

Experiment M.35/2. Fields 20B 14C Boundary Rows R.R.I. Experiment Station — A mixture, used extensively on a Chinese estate for the stimulation of bark renewal, has been applied in a pilot experiment to three rows of 9 buddings each in Field 20B and 14C (boundary rows). This mixture consists of sea mud, soya bean refuse, rough salt, oven ash, 'Tayko' (diluted DDT) composted for four days and mixed with Diesel oil.

Treatments which began in the first quarter of 1951 are:

(*a*) Application of the mixture at a height of 12 inches above the tapping cut over all the tapped bark;

(*b*) Application of the mixture over all the tapped bark from the tapping cut upwards;

(*c*) No application.

By the end of 1951 there seemed to be some slight beneficial effect of treatments, but comment will be reserved until further data are available.

TABLE XLVIII: YIELD STIMULATION EXPERIMENT

Jungle plot 'B' R.R.I. Experiment Station

	Mean pre-treatment yield	*Yield increase during first month after treatment*	*Yield increase during second month after treatment*
No treatment (control)	42.3	– 1.4	+ 2.5
Scraping of 3 inch strip of bark below the tapping cut	39.5	+ 3.3	+ 5.0
Palm oil applied to 3 inch strip of scraped bark	55.3	+ 5.8	+ 3.0
Palm oil applied to 6 inch strip of scraped bark	38.3	+ 3.8	+ 4.7
0.1% 2,4-D(Na-salt) in liquid paraffin to 3 inch strip of scraped bark	40.8	+ 4.2	+ 4.5
0.1% 2,4-D(Na-salt) in palm oil to 3 inch strip of scraped bark	43.5	+ 7.5	+ 6.1
*1% 2,4-D(Na-salt) in palm oil to 3 inch strip of scraped bark **	41.3	+ 11.5	+ 8.3
*Proprietary yield stimulant A to 3 inch strip of scraped bark **	41.6	+ 14.4	+ 8.6
*Proprietary yield stimulant B to 3 inch strip of scraped bark **	39.3	+ 14.6	+ 11.3
0.1% 3-indolybutyric acid in liquid paraffin to 3 inch strip of scraped bark	33.5	+ 2.5	+ 4.9
0.1% 1-naphthalene acetic acid in liquid paraffin to 3 inch strip of scraped bark	45.1	+ 3.1	+ 5.3
0.1% p-chlorophenoxy acetic acid in liquid paraffin to 3 inch strip of scraped bark	39.7	+ 4.4	+ 4.5
0.1% 2-naphthoxyacetic acid in liquid paraffin to 3 inch strip of scraped bark	41.8	– 1.0	– 1.5
0.1% 1-naphthoxyacetic acid in liquid paraffin to 3 inch strip of scraped bark	38.1	+ 7.4	+ 8.1

*Only the treatments marked * have given yields significantly greater than those of the control (P=0.05)*

V

ECOLOGY

ASSOCIATION OF HEVEA AND INDIGENOUS FLORA

The cultivation experiment of Field 27 R.R.I. Experiment Station* continues in recording though no transect analysis of the ground vegetation has been made since 1949. In August 1948, the following modifications were made in the cover crop treatments.

Treatment I. All tree species among natural covers which had grown taller than 25 feet were killed by poisoning.

Treatments II and III. Self sown rubber seedlings had become dominant and in order to determine how the development of these seedlings affects the natural regeneration of indigenous plants all plots were divided into two sections in one of which all rubber seedlings were eradicated.

Treatments IV and V. Rubber seedlings had become dominant with a few species of indigenous plants developing among them. All the original leguminous shrubs in treatment *IV* and most of the leguminous creepers in treatment *V* had disappeared.

The plants were slashed to a height of three to four feet and been controlled by yearly slashing. The creeping grasses *Paspalum conjugatum* and *Axonopus compressus* and other harmful weeds are eradicated during weeding rounds.

Statistical analysis of the girth data for 1948 has revealed significant effects of cultivation treatment on growth of the rubber trees. Growth in treatment *V* (Leguminous creepers) and treatment *III* (Natural covers – C: growth controlled by slashing to three feet at half yearly intervals and all ferns eradicated) is significantly better than in treatment *IV* (leguminous shrubs) and treatment *I* (Natural covers – A: minimum control).

Growth in treatment *II* (Natural covers – B: with some weed species eradicated) is not significantly different from that in the other cultivation treatments. The effects of cultivation treatments on girth increments over the period January 1948-50 are not proven.

Statistical analysis of yield data for the period January 1948 to December 1950 shows very marked significant effects between types of planting material as seen in TABLE XLIX.

* *Rep. Rubb. Res. Inst. Malaya* (1934) 90, 147, (1935) 97, 137, (1936) 72, 127, (1937) 128, (1938) 106, (1039) 146, 223, (1940) 79, 136, (1941-5) 30, 38, (1945-8) 87

TABLE XLIX: MEAN YIELD (GM) PER TREE PER TAPPING

Cultivation treatments (covers)	*AVROS 49 seedlings*	*AVROS 50 seedlings*	*Unsel. seedlings*	*Mixed clonal seedlings*	*Buddings*	*Cover means*
I. Natural: A	46.06	36.48	27.50	38.76	47.24	39.21
II. „ : B	43.66	37.88	29.80	40.80	52.66	40.96
III. „ : C	46.84	37.20	25.10	39.94	46.34	39.08
IV. Leg. shrubs	44.62	38.88	28.18	40.36	46.82	39.77
V. „ creepers	46.30	34.82	26.06	33.36	46.90	37.49
Planting material means	45.50	37.05	27.33	38.64	47.99	

		significant difference	
Standard error of difference		5%	1%
between 2 'planting material' means	= 1.653	3.50	4.83
„ 2 'covers' means	= 1.061	2.25	3.10
„ 2 'planting material' having the same type of cover	= 3.383	6.86	9.20
„ 2 'covers' means for the same type of planting material	= 3.316	6.67	8.92

Differences between planting materials are very marked with buddings and AVROS 49 seedlings giving relatively high yields and unselected seedlings giving distinctly low yields.

A significant cover effect is not firmly established but there is some indication that treatment *V* (leguminous creepers) has had an adverse effect on yield.

Since statistical analysis of the tapping records up to 1950 showed no interaction between ground cover and planting material, TABLE L gives only the mean yields per tree for all planting materials with each kind of ground cover.

Natural covers, slashed every six months to a height of 3 feet and selectively weeded, continue to give the best return.

V(2) ESTABLISHMENT OF INDIGENOUS OR INTRODUCED SPECIES IN PLANTED AREA

A herbaceous half shrubby plant, *Clidemia hirta* known as hairy Clidemia which belongs to the same Natural Order (*Melastomaceae*) as the Straits Rhododendron, is being established as a cover in rubber areas on an estate in the Paloh district of Johore. The plant which is indigenous to South America is very abundant in

TABLE L: CULTIVATION EXPERIMENT

Field 27 R.R.I. Experiment Station

	Cultivation treatments	*Mean girth (in) at 50 in from ground January 1950*	*Girth increase April 1940-Jan '50*	*Yield in lb/tree/year*			
				*1948**	*1949*	*1950*	*1951*
I	*Natural covers – A Minimum control*	33.7	15.7	16.0	12.9	12.6	11.9
II	*Natural covers – B Slashed every six months to 3 ft*	34.3	15.6	16.5	13.6	13.2	12.3
III	*Natural covers – C Similar to II but all ferns eradicated*	34.5	15.8	15.5	12.8	12.6	12.0
IV	*Originally planted with leguminous shrubs but now under young rubber seedlings Slashed as in II & III*	34.1	16.0	15.8	13.3	12.9	11.8
V	*Originally planted with leguminous creeping covers but now as in IV*	35.0	16.0	15.7	12.1	12.5	11.7

* *New panel opened on seedling trees at 30 in from the ground in October* 1948

the district, having spread from Singapore Island where it is common on roadsides and in waste places.

Cuttings of *Stylosanthes gracilis*, a newly introduced legume from Brazil, have been obtained from the Department of Agriculture and established on the R.R.I. Experiment Station. The plant which is said to grow vigorously in a semi-erect manner will be propagated for trial as a cover plant. It would be a useful economic plant for growing on estates as it is palatable to cattle and its food value (in Queensland Australia) is said to equal that of lucerne.

Seeds of *Flemingia strobilifera* have been obtained from the Department of Agriculture. The plant grows to the same size as *Flemingia congesta*, which makes an excellent cover in young areas on the R.R.I. Experiment Station. It will be tried out as a cover in new clearings.

(3) ECOLOGY OF MIXED CULTIVATION

Reference will be found on page 67 of this report to a trial of mixed cropping of rubber and cacao in which the effect of various shade trees necessary for the cultivation of cacao is being studied. Owing to the difficulty of getting a satisfactory establishment of shade trees in the open section of this planting, no information is yet available.

In the jungle section in which different degrees of poisoning of the jungle trees have been undertaken preliminary observation suggests that where the stand of trees is sufficiently reduced, the rubber plants can be established.

MISCELLANEOUS

EXPERIMENTS SET UP UNDER THE RUBBER REGULATION SCHEME

These trials have been noted in the relative sections of this report. An analysis of those still in recording at the end of 1951, or which had ceased during the years 1949-51, is given in TABLE LI.

The cooperation of estate Managers, particularly in the present difficult time, is very greatly appreciated. Without their unstinted help and that of their field staff a very large proportion of the work of this Division could not take place.

TERRORIST SABOTAGE

Since the beginning of the Emergency several cases of wilful damage to trees on the R.R.I. Experiment Station and in experimental areas on estates have occurred.

TABLE LI: FIELD EXPERIMENTS ON ESTATES

Analysis of experimental planting trials established prior to 1942

	Type of experiment	In recording 31 December 1951		Recording ceased 1949 to 1951		
		No.	Acreage	Terrorist activity	Concluded	Total acres
1	a. Standard clones trials	1	57.2	–	–	–
	b. Standard clones trials cum tapping experiments	3	233.2	–	–	–
2	Subsidiary clones trial	5	61.8	–	–	–
3	a. New clones trials on virgin land	12	421.3	3	1	80.8
	b. New clones trials on replanted land	4	69.5	1	–	10.6
4	Stock experiments	1	28.0	1	1	88.0
5	Clonal seedling trials	11	477.2	3	2	191.0
6	Tapping experiments	1	60.0	–	–	–
7	Density of planting experiments	1	80.2	–	1	85.0
8	Methods of planting experiments	1	56.0	–	–	–
9	Agency trials (in cooperation with R.R.I.)	1	80.0	1	1	97.9
	TOTALS	41	1624.4	9	6	553.3

On the R.R.I. Experiment Station during the night of the 10/11 June 1951, terrorists slashed nearly every tree in tapping and broke all the latex cups in Field 42N and 42W. The trees damaged were of the 134 clones made from the 1940 hand pollinated seedlings, and included the small scale trial material of the four RRIM 600 Series clones shown in TABLE XVIII. The balance of the damage extended into an area budded with clone RRIM 501 on which a tapping experiment was being conducted. The damage sustained may be summarised in TABLE LII:

TABLE LII: BARK DAMAGE

Nature of damage sustained by trees	*Small scale trial of R.R.I. clones*		*Tapping expt. clone RRIM 501*		*Total*	
	Number	%	*Number*	%	*No.*	%
Parang cuts	44	5.4	27	6.6	71	5.7
Ringbarked up to 6 inches	173	19.0	61	14.5	234	17.6
Ringbarked 6 inches-3 feet	483	53.1	187	44.3	670	50.3
Ringbarked within reach	7	0.8	7	1.7	14	1.1
Small trees with bark damage	8	0.9	13	3.1	21	1.6
Large trees in tapping undamaged	101	11.1	24	5.7	125	9.4
Small trees undamaged	89	9.7	103	24.7	192	14.3
Total	905		422		1327	

	% damaged	*% undamaged*
All trees	76	24
Trees in tapping	89	11
Small trees (not tapped)	10	90

Recording has ceased in these fields and bark treatment experiments are now in progress.

In experimental areas on estates, damage has been done to eight trials. In one instance the slashing of trees of the clones which were planted in plots in a randomised layout was so selective of the higher yielding material as to suggest that the work must have been carried out by persons well acquainted with that particular field.

The extent of the damage done to Botanical Division Trials is:

Estate	*District*	*Experiment*	*Date of damage*	*Extent of damage*
39	Bahau	RRIM clones	17.10.50	401 trees in 10 plots
„	„	„ „	1.11.51	52 „ „ 4 „
„	„	Estate clones	1.11.51	72 „ „ 4 „
62	„	Stock/Scion	19. 6.50	1978 „
„	„	2 x Clonal seedlings	24. 4.51	653 „ „173 „
73	Klang	RRIM clones	6. 9.51	552 „ „ 24 „
9	Kluang	Clonal seedlings	27. 5.51	587 „ „ 15 „
„	„	Subsidiary clones	23. 9.51	678 „ „ 15 „

Partly owing to this attention and partly because of the difficulty in maintaining proper tapping under the existing conditions eight trials have had to be abandoned. We regret to record the murder by terrorists of one estate conductor who supervised the R.R.I. work.

ADVISORY WORK AND OTHER ACTIVITIES

Correspondence – The number of letters received has varied somewhat from year to year. The number in 1949 was over 1700, in 1950 over 2000 and in 1951 just under 1600. The commonest inquiries have been on the choice of planting material and on matters connected with replanting.

Pamphlets issued:

B/AL 26 (50) Instructions for Test-tapping and Thinning-out. (Revised)

B/M 44 (49) Poisoning Rubber Trees.

Interviews visits — Seventysix planters and others visited the Division in 1949, seventynine in 1950 and fortyeight in 1951. Advice sought was usually on the choice of planting material, replanting and tapping problems.

An analysis of extra-mural work by the Divisional Staff is:

Visits	*1949*	*1950*	*1951*
Graduate staff to estates	55	73	21
Budding mandor to estates (identification of clones)	54	50	13
Field assistants to estates	197	281	253
Graduate staff to Experiment Station	382	418	190

The Head of the Division visited a number of estates in the Colony of North Borneo in early 1951.

PUBLICATIONS

DURING THE YEARS 1949 to 1951 the following publications were issued:

'Progress of Breeding Investigations with Hevea Brasiliensis, II' by C.C.T. SHARP, *J. Rubb. Res. Inst. Malaya* 13 (1951) 73 (Communication 275).

'Poisoning of Rubber Trees with Sodium Arsenite.' Circular No. 29.

An abstract of the following contribution to the Latex Symposium held at the R.R.I. in February 1951 was published in the Institute's Journal, Vol. 13, Communication 276 of December 1951:

Preliminary Studies in the Physiology of Latex — E.G.B. GOODING

Officers have also contributed the following articles to *The Planter*:

E.G.B. GOODING. Full Spiral Tapping. *Planter, Kuala Lumpur* 25 (1949) 331

C.W. BROOKSOON, Clone PR 107 (LCB 510) A Critical Appraisal. *Planter, Kuala Lumpur* 28 (1952) 54

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Kuala Lumpur
December 1952